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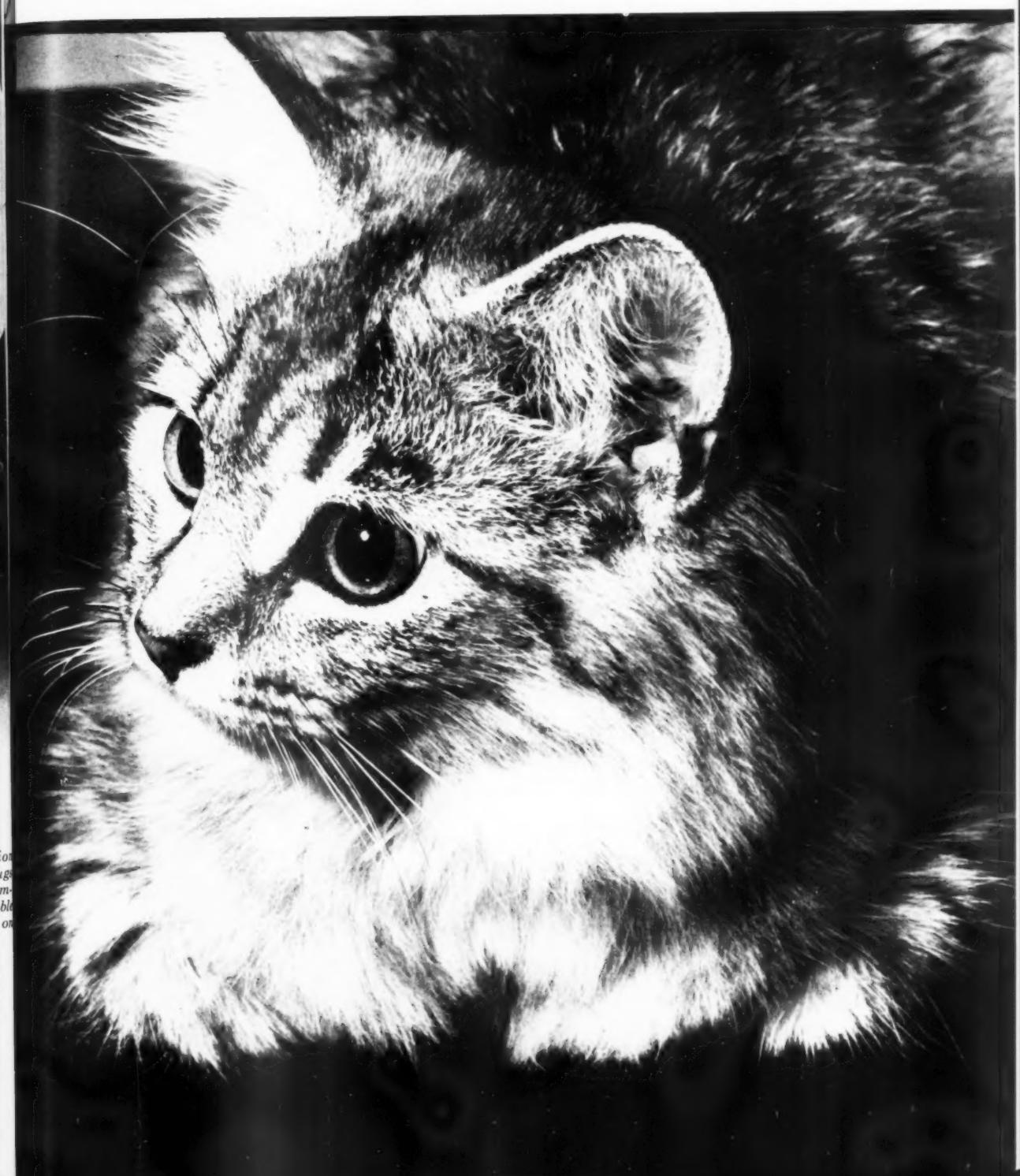

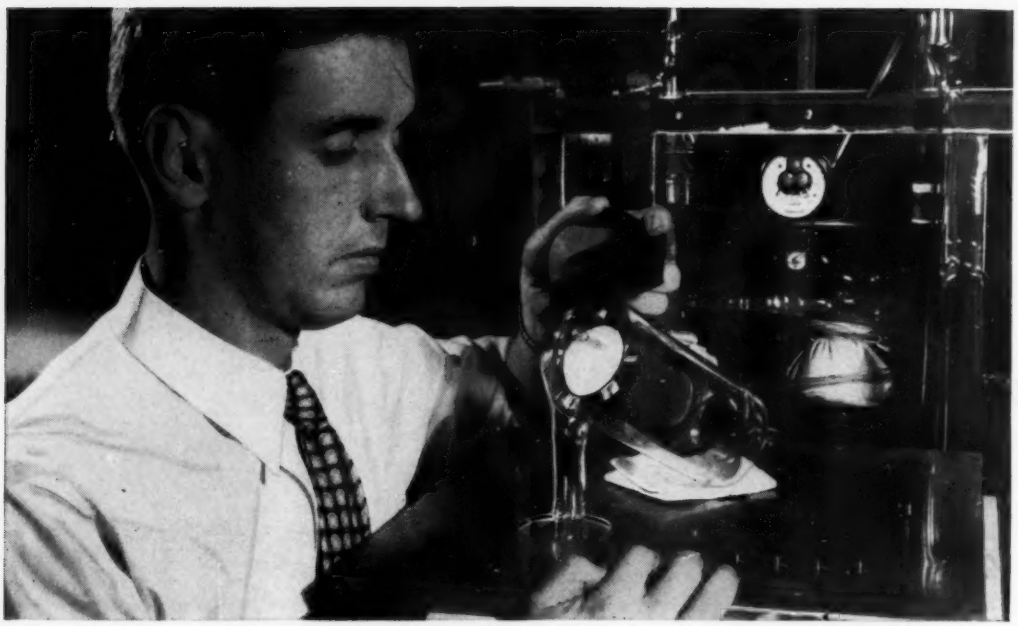

Arthur E. Anderson, Professor of Electrical Engineering at the University of Connecticut, was one of the 21 college professors who spent the summer months last year working with the men who design and build electrical equipment for the Westinghouse Electric Corporation. The program is designed to provide college instructors with practical experience in industry. Here, as part of a research project, Mr. Anderson is using a small magnet to change the position of a metal disc enclosed in a glass tube.

Westinghouse Plan Enables Professors to Deal with Actual Industrial Problems . . .

Through a "lend-lease" program with leading engineering colleges, Westinghouse hopes to enable professors of those schools to get a greater understanding of industrial research, design and manufacturing problems.

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In this way, Westinghouse hopes to contribute to the flow of well-trained and competent engineers coming from America's educational institutions.

Other Westinghouse co-operation with colleges is by supporting 42 fellowships, 149 scholarships, 5 professorships, and a graduate study program through which Westinghouse employees may work toward advanced degrees at seven co-operating universities.

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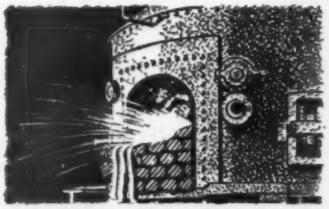

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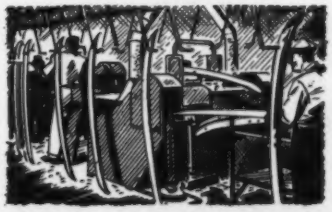

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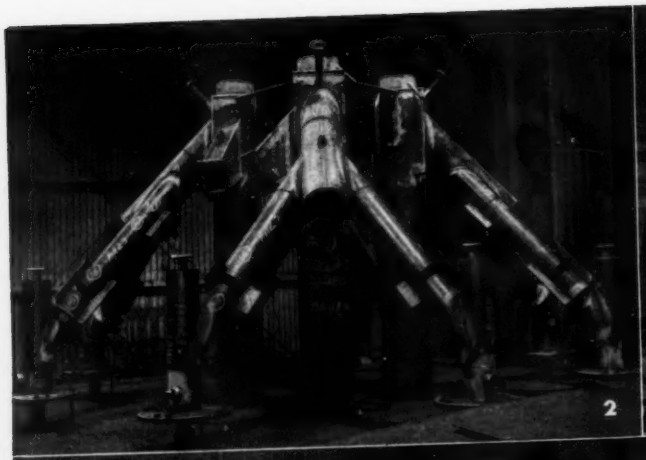

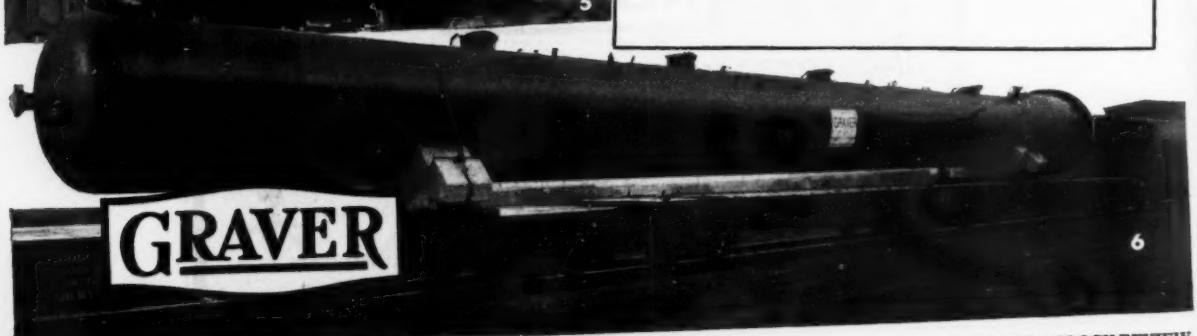

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These pictures show the significant part Graver is taking in the modernization and expansion of the nation's refinery facilities.

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2. Part of a Catalyst Airlift
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4. Houdry Process Vessel of molybdenum steel, 12′0″ x 50′0″
5. Desalting Tank, 12′0″ x 40′0″
6. Refinery Tower, 7′0″ x 102′11″

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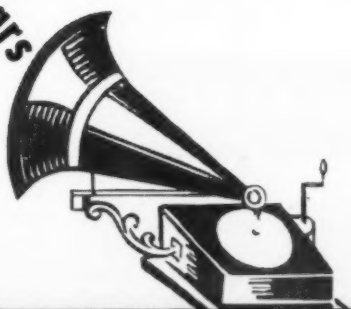

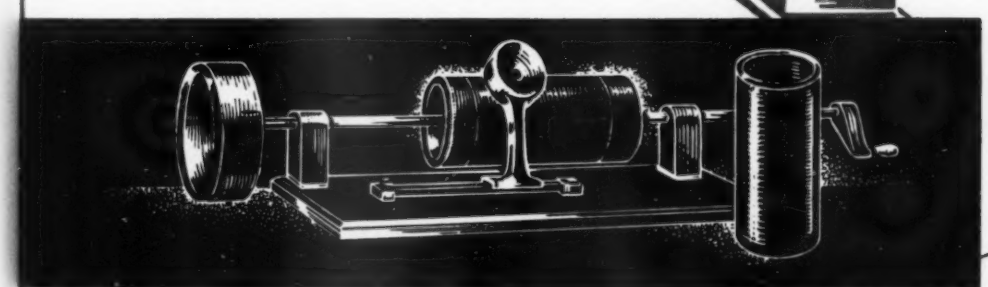

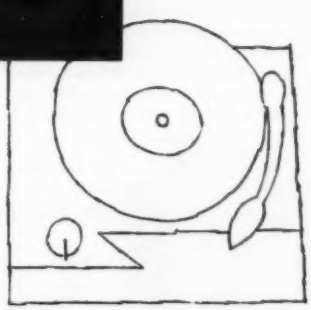

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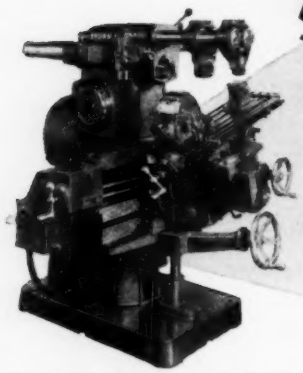

Here's the ultimate in milling machine versatility! The new Brown & Sharpe No. O Omniversal Milling Machine mills compound angles, bores multiple holes from different directions, cuts teeth in tapered cutters —and many other operations—without special attachments, jigs, fixtures, or resetting work on the table. Saves set-up and machining time. Ideal for toolrooms, experimental laboratories, and small-quantity production plants. Write for complete information. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

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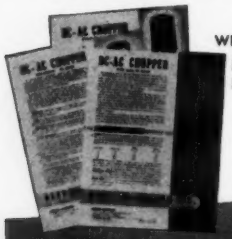

WRITE FOR CATALOGS . .
#246B, 60 cycles, AC
#280, 400 cycles, AC

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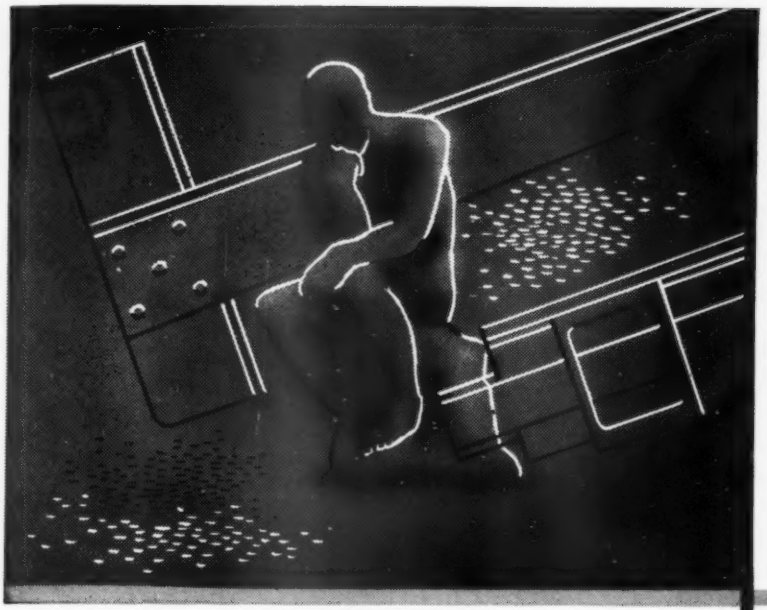
THE TABULAR VIEW

Great Dream. — For centuries, while the geographical areas of the world's known land masses were being gradually expanded, men feared the Great Unknown Southland as an obstruction to land travel; later *Terra Australis* was looked upon as a vast expanse of rich land awaiting exploitation and colonization. But the hardy, fearsome sailors of an earlier era found that no matter how far their travels carried them, the Great Southland always receded out of reach. What comedy of errors led to the age-old belief that such a region ever existed is discussed in the first installment of a two-part article (page 292) by WILLY LEY. Like other articles Mr. Ley has written for The Review as one of its editorial associates, "The Great Dream" echoes his special interest in history and science. Mr. Ley was one of the founders of the German Rocket Society and later became coeditor of its journal. He was science editor of PM during the heyday of that New York daily, and spent the years of World War II in research at the Washington Institute of Technology.

Life's Objective. — Normally one wouldn't expect morals to be influenced by mathematics. Yet when a mathematician turns philosopher, such may easily be the case. At any rate, starting with the thesis that continued advancement is the goal of all living organisms, PROFESSOR EMERITUS HENRY B. PHILLIPS shows (page 298) that most rapid progress occurs when the probability of finding correct solutions to the way of life is maximized, as it is under conditions of individual liberty. Professor Phillips received his bachelor's degree from Erskine College in 1900 and a Ph.D. from the Johns Hopkins University in 1905. He joined the Technology staff in 1907. Professor Phillips became a full professor in 1927 and in 1934 was appointed acting head of the Institute's Department of Mathematics, becoming its head in 1935. He has also been a consulting professor of physics at Brown University, and a lecturer at the University of California. He is author of more than 20 books and scientific papers.

Charles River Sailing. — In 1936 an important new sport was brought to Technology with the acquisition of a fleet of sailing dinghies. WALTER C. WOOD, '17, sailing master, recalls (page 301) the outstanding influence which the Technology fleet has had — not alone in influencing sports at M.I.T. but in injecting a new spirit of intercollegiate competition in sailing throughout the country. Mr. Wood learned the fundamentals of yachting at an early age at his home in Providence, R.I. He was a member of the committee appointed by Karl T. Compton, chairman of the M.I.T. Corporation, in 1936, to design a boat suitable for racing, as well as for training large numbers of Technology students, and subsequently became master of the M.I.T. Nautical Association. During World War II, he was instructor in sailing at the U.S. Coast Guard Academy in New London, with the rank of lieutenant commander. After the war, he returned to M.I.T. and is now engaged in studies of dinghies constructed from Fiberglas, as the original Technology dinghy fleet nears the end of its useful life.



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"Improving" any machine really means increasing its productive capacity. That means tinkering with speeds and weights and strength—ending up with alloy steels.

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MAIL RETURNS

A Will and a Won't

FROM WILLIAM A. RHODES, '12:

Dr. Paul Meadows,
In "Technological Change and Social Progress,"
In your January issue,
Recognizes difficulties in forecasting sociological change.
A step in the proper direction.
For, while – cause – effect – cause – effect – etc.
Is dependable in lifeless matter,
Rendering material sciences and their predictions possible,
People are different.
Each person (the cuss) has a will of his own which may act
As a primary cause
With or without good, bad, valid, or invalid reason.
At its own option it frequently does so.
Thus, sociological forecasting is not only difficult
But so largely impossible that
Unexpected events and developments are bound to occur.
And they do.
Each person has also a won't.
New York 23, N. Y.

Performed to a *T*

FROM ANDREW L. FABENS, '10:

Thank you for your article in the December, 1950, issue of The Review entitled "William T. Sedgwick, Biologist." It has brought up so many pleasant memories of M.I.T.

Professor Sedgwick was such an interesting teacher back in my days of 1907-1910 that those of us who signed up for his general course in public health had to dash to his lectures or we would find our seats and the room filled with others who had not signed up. I think the interlopers outnumbered those who signed up.

In my student days, only one other man had such an appeal. He was Dean Shaler, the geologist at Harvard, who gave his lectures in the Harvard Museum to discourage the influx of visitors.

In my days of reporting for *The Tech,* I got Professor Sedgwick to give me articles each week about his course, but this ended very suddenly and finally when a frivolous printer changed a lecture subject from "Infant Mortality" to "Infant Morality."
Delray Beach, Fla.

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Philadelphia

This plant of Canada Dry Ginger Ale, Inc.—one of two recently erected by us—is typical of the many new streamlined factories that are enabling their owners to produce more efficiently. A vital factor in today's competition!

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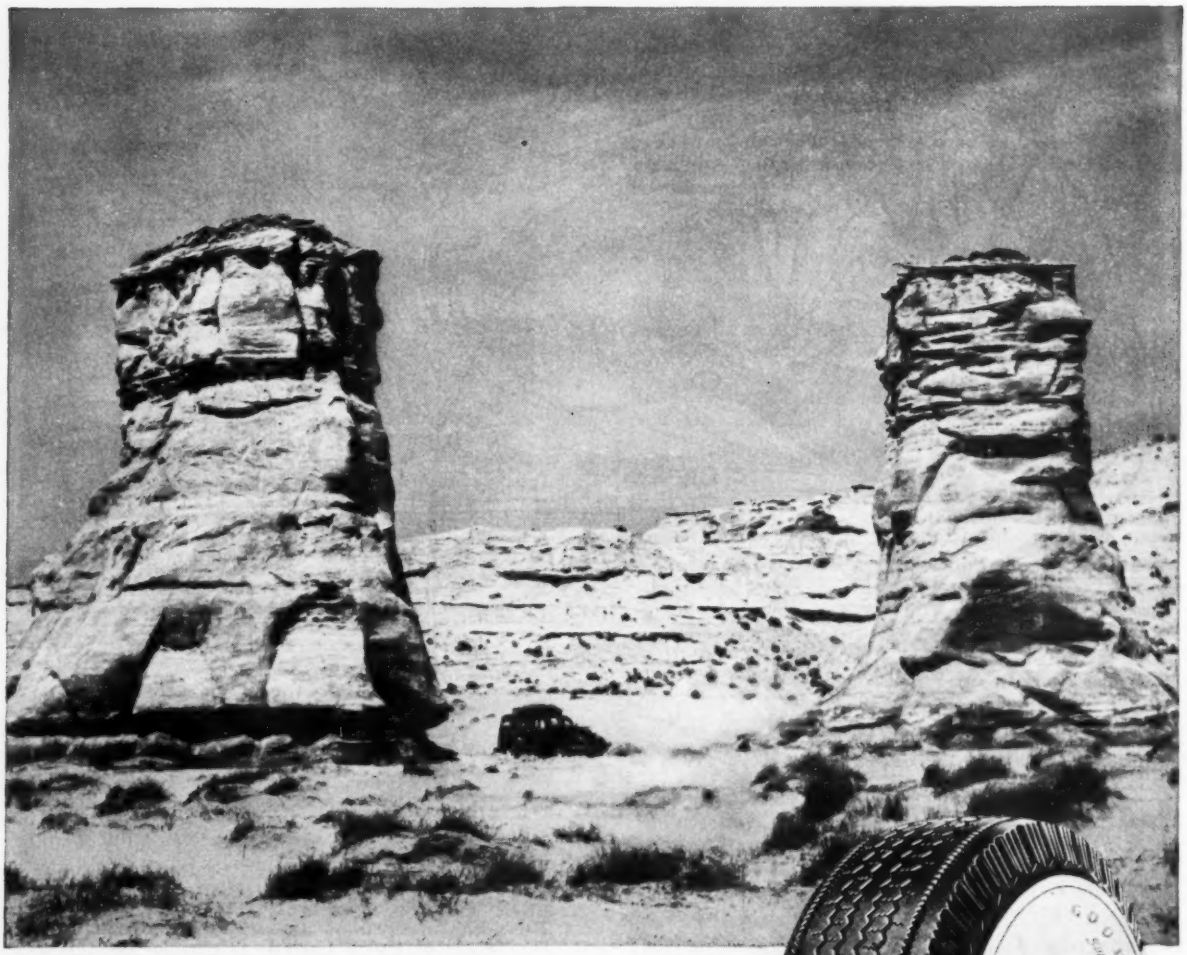

Traveling to the Arizona Desert (*above*)—or to any other spot in our beautiful country—more cars roll on Goodyear tires than on any other kind. And it's to your *advantage to know why!*

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Super Cushion by

GOODYEAR

Super-Cushion, T. M.—The Goodyear Tire & Rubber Company, Akron, Ohio

THE TECHNOLOGY REVIEW

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A wide diversity of ideas, freely explored in a democratic society, is held to be the key to continued progress

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For 15 years Technology's well-used dinghy fleet has provided wholesome recreation, brought home many trophies, and impelled competitive intercollegiate sailing in the United States and Canada

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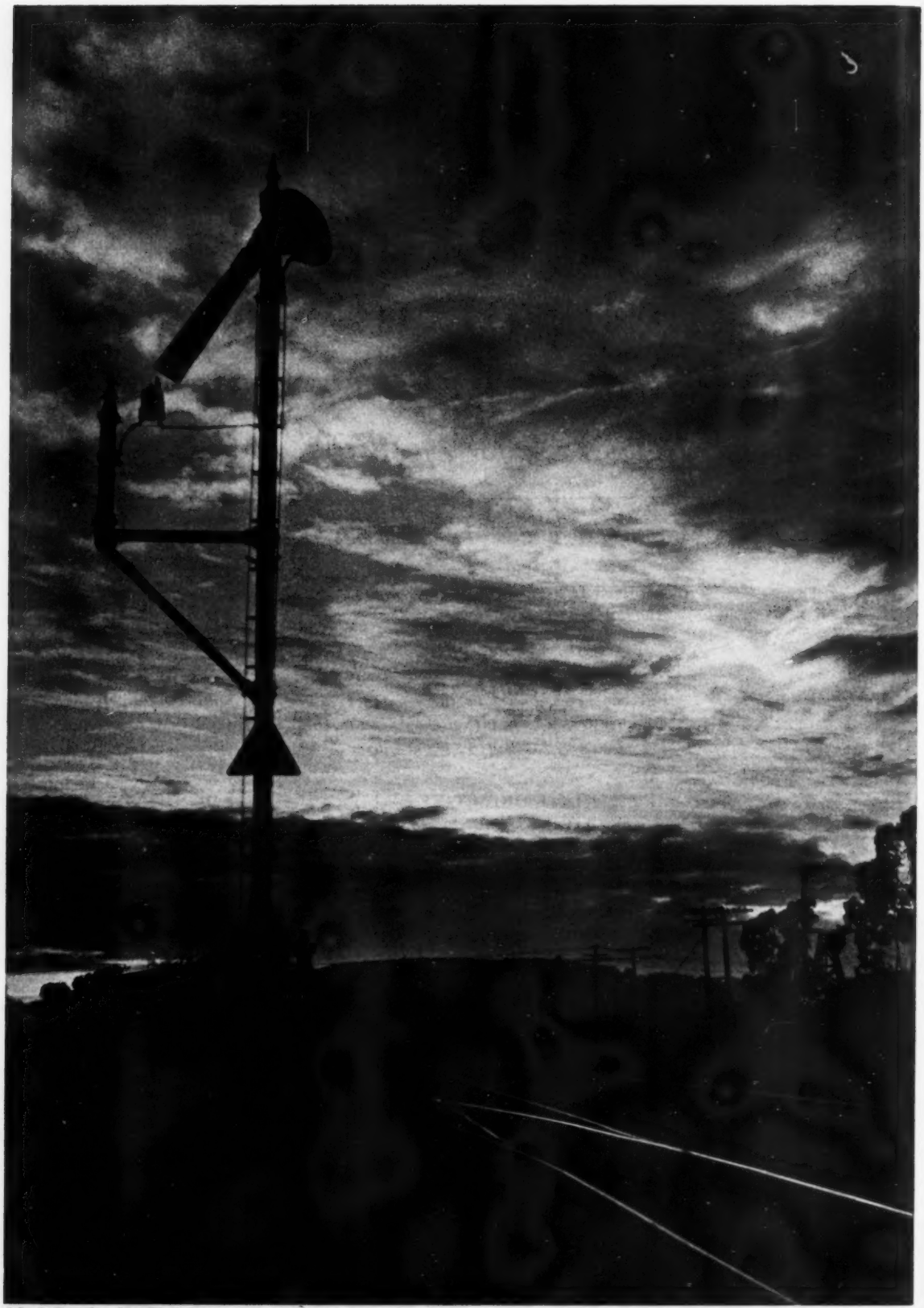


John J. Hanrahan from Black Star

Sentinel at Dusk

THE
TECHNOLOGY
REVIEW

Vol. 53, No. 6 April, 1951

The Trend of Affairs

A Nation of Home Owners

THE past 10 years of war dislocations and postwar building boom have brought about great changes in the distribution and housing habits of our population. The continuing movement from farm to city should cause no surprise, for it is a trend of long duration. The drift of population from the interior states to the coastal areas, and particularly to the southwest corner of the country, has also received wide publicity. Perhaps less well known is the fact that in spite of the heavy flow from rural areas, the large cities of the country are growing either very slowly or not at all. The reason, of course, is the countertide from the cities into suburbia.

But very likely more important, economically and politically, than any of these trends is a phenomenal rise in home ownership, mainly during the past five years. The United States now has more home owners than tenants. In the past decade the number of home owners, excluding farmers, has almost doubled, rising from 11,413,036 in 1940 to about 22,000,000 in 1950. Some 5,500,000 single family houses were erected during those 10 years, with 2,325,000 of them going up in 1949 and 1950 alone. Over and above mortgages, these individually owned houses represent a net equity of about $160,000,000,000 — nearly twice the value of bank savings deposits. Though we may be witnessing the decline, we have not yet seen the fall of the landlord. During this period the number of urban tenants dropped to its present level of 13,000,000 — a decrease of 3,000,000.

Spurred by virtually full employment and unparalleled prosperity, American families have followed their desire for a home and a piece of land of their own out into the farms and pastures surrounding our cities. Primarily because of the automobile, this has been an economically and physically feasible movement. By no means a negligible factor in the growth of America's suburbia have been the 35,000,000 children born in this country between 1940 and 1950.

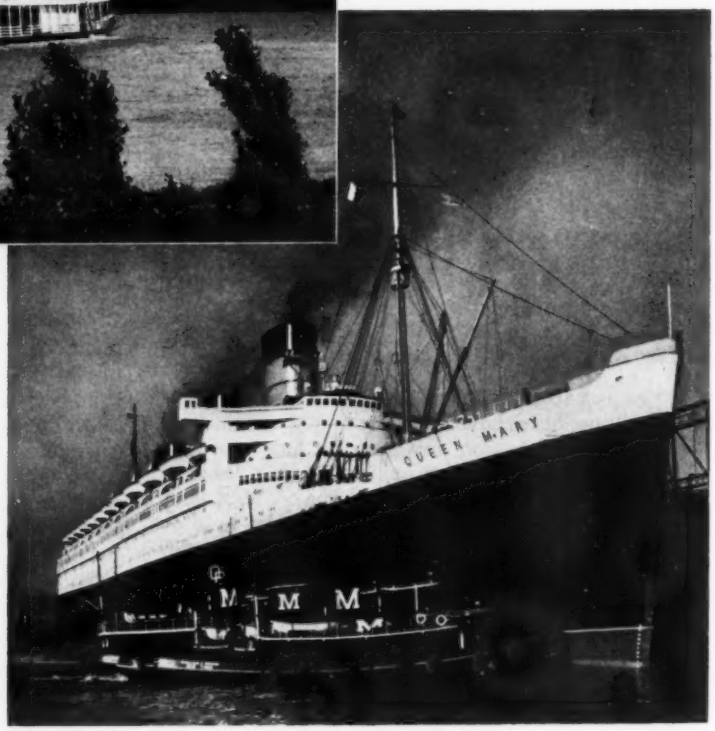
Another powerful incentive has been the dearth of adequate housing, felt most intensely by the middle class, within the cities themselves. A most extreme example of this is to be observed currently in Manhattan which, many observers fear, is slowly being stratified into a two-layer town. A city with the highest percentage of old or substandard dwellings in the New York area, Manhattan has seen luxurious, high-rent apartments built freely by unassisted private capital to the point where signs of a surplus of this type of dwelling are apparent. On the other hand, towering housing developments subsidized by municipal or federal monies have also been created, but generally with some upper limit to the income of the tenants. In the last few years, the only large-scale developments aimed at the middle class that have been constructed on the island of Manhattan are the Metropolitan Life Insurance Company projects on the lower East Side, known as Peter Cooper Village and Stuyvesant Town, containing together 11,250 dwelling units. Some 200,000 applications were received for the 8,755 apartments in Stuyvesant Town before the owners stopped accepting any more. Faced with crowded schools and a dearth of adequate housing, the middle class has no choice but to run for the wide-open spaces of Queens, Nassau, and Westchester counties, or the hills of New Jersey.

Of the nation's 22,000,000 nonfarmer home owners, nearly 20,000,000 live in single-family houses. (Another 3,000,000 such dwellings are rented.) About 1,500,000 home owners live in this country's 5,250,000 two-family structures, and 300,000 owners occupy space in houses containing three or four flats. Although one is apt to imagine the American urbanite as a cliff dweller, ascending by elevator after his day's work to

Got any river they say isn't crossable?
Got any mountains that can't be cut through?
We specialize in the wholly impossible,
Doing things "nobody ever could do."

—Berton Braley

Ward Allan Howe



It is Europeans, for the most part, who have constructed these great ships, but without America they have no meaning. These ships are alive with the supreme ecstasy of the modern world, which is the voyage to America. There is no other experience that is remotely comparable to it, in its sense of joy, its exultancy, its drunken and magnificent hope which, against reason and knowledge, soars into a heaven of fabulous conviction, which believes in the miracle and sees it invariably achieved.

—Thomas Wolfe

some fifteenth-story domicile, only in New York and Chicago are there more people living in apartment houses than in the smaller dwellings.

Sharing to a growing degree this trend toward home ownership are the nation's many minority groups. Having generally a marginal position in the competition for jobs, their economic situation has been strongly improved, relatively, by the seller's market for labor that has existed during the past decade. They have also been aided greatly by an improving social climate, and by a series of antidiscrimination laws and court decisions. A notable one was that by the Supreme Court in 1948 which ruled that written agreements among property owners against selling to Negroes could not be enforced in court.

The automobile has contributed its share to the development of suburban, and even rural, living; it has even stemmed the trek to the cities. The United States is rapidly becoming a nation of home owners.

High-Speed Recording

LORD KELVIN's statement, to the effect that knowledge in any field of inquiry remains unsatisfactory and incomplete until the essential characteristics are brought within the compass of measurement, gets to the core of modern science and technology. But the world had a more leisurely pace in Kelvin's time than in the mid-Twentieth Century, and today the mere measurement of quantities no longer suffices by itself. We need to make measurements – precisely, of course – but we need to record them quickly as well. The measurement of physical quantities is not usually too difficult a problem, but the recording of the measured data often sets up obstacles to progress, especially if the counting rate is rapid and the records are desired quickly.

The prompt and accurate recording of data in permanent form is especially significant in processes for which a considerable amount of information must be

determined rapidly during a relatively brief interval of time. In such cases, of which flight studies of guided missiles may be cited as one example, it is not uncommon for information to be received over a radio telemetering link or perhaps by way of an electric circuit. In this case, information from electrical gauges is transmitted to a receiving point where it has usually been recorded photographically as a function of time. Numerical values of the quantities under measurement can then be obtained manually through application of a known calibration to the recorded curves. But the process of analyzing the recorded data is time consuming. Whereas the required information may be recorded in an interval of a few minutes, days or even weeks may be required to translate the oscillograms into numerical data necessary for advancing the research in progress.

To reduce the time required for such operations an automatic data-reducing device has been developed by William F. Santelmann, Jr., a research assistant in the Institute's Laboratory of Electronics – operated jointly by the Department of Electrical Engineering and the Department of Physics. The device consists of a data scaler and printer. The data scaler receives a time-varying electrical signal whose voltage is proportioned to the quantity being measured. From the received signal, the data scaler then determines the numerical value of the measured quantity, accurate to within ± 2 parts out of a full-scale count of 999. The second unit, or printer, records the measured value of the quantity by printing three digits in Arabic numerals on moving paper tape at a rate of up to 100 values per second. Printing is accomplished without any delay for processing, as would be required in photographic recording, for example, and records are permanent.

The immediate availability of measured results, coupled with permanence and speed of printing, is accomplished by electrical rather than by photographic or mechanical recording. In the printing operation, use is made of Teledeltos paper, commonly used for facsimile reception. This paper has the property of changing its color at those points at which a sufficient voltage is applied between its surfaces; the change due to the application of the voltage taking place immediately and remaining permanent. With such recording paper, the desired records may be obtained by printing a group of dots so arranged as to form Arabic numerals.

Each digit is created on the electrically sensitized paper by an array of 15 dots, arranged in five rows of three columns each. Since three digits may be printed simultaneously, there are three electrode groups of three electrodes each arranged in a single row across the paper. Each electrode, under the control of the data scaler, prints dots in one column which are appropriate to the formation of the desired numeral. Since only one electrode is assigned for a column containing up to five dots, these dots must be printed sequentially, from top to bottom, as the paper moves beneath the electrode. The appearance of the resulting numerals is similar to the dot-formed numerals on electric scoreboards or news bulletin signs.

The printing process has no inherent limitation of printing time and, if necessary, printing could be increased to a rate of several hundred characters per second. At present, three columns of five dots each are used for each numeral. If a display of about 35 dots were used (instead of 15, as at present), it would be possible to print all the characters of the typewriter keyboard. Therefore, an elaboration of the present printing system holds out the possibility of sending messages at a much greater speed than is now possible with the usual teletype equipment.

Irwin Fait

Aside from its use in telemetering, this device has application to many fields where electrical data are to be recorded, particularly at high rates. Since it is usually a comparatively simple matter to convert almost any physical quantity into an electrical voltage, the benefits of the data scaler and printer are not restricted to the measurement of electrical quantities. Conceivably, processes which now depend upon manual or mechanical data-handling could be speeded up by a large factor by application of the principles developed in this data scaler and printer.

The Earth's Atmosphere

IMPROVED weather-predicting techniques are expected to result from research, now in progress, to study the complicated meteorological conditions which give rise to changes in the earth's atmospheric pressure. The success of weather forecasting is intimately related to knowledge of the changes in the earth's atmospheric pressure. For this reason, meteorologists are seeking an explanation for the mechanism of observed pressure changes.

In brief, the pressure at a point is the weight of the air column above that point, so that the pressure changes whenever there is a net change in the mass of air above the point where pressure is measured by a barometer. This change requires density changes in a vertical column of air, together with the motion of air

in or out of the column. The problem then involves variations in the fields of density and air motion.

It may seem surprising that the problem of the mechanism of pressure change still exists after about a century of weather forecasting. This state of affairs may be attributed mainly to the complexity of the problem as evidenced by the fact that the pressure change is always the small difference between the large contributions of different processes taking place at different levels in the atmosphere. The absence of information on the state of the atmosphere above the earth's surface has also been an important factor in limiting understanding of pressure changes. About 10 years ago, regular observation data on temperature, pressure, humidity, and wind above the earth's surface, taken twice daily over a vast area, became available for the first time. These observations made it possible for the meteorologist to test existing theories of atmospheric phenomena and to investigate the actual changes which take place in the temperature and wind field above the earth's surface.

As a result of a research project started in 1945, and directed primarily toward the analysis and synthesis of the empirical information on temperature, wind, and pressure, it appears that we now have a reasonably consistent picture of the changes in temperature and wind which accompany the pressure change at the earth's surface. The current program, under the direction of James M. Austin, '41, Associate Professor of Meteorology, and Professor Henry G. Houghton, '27, Head of the Department of Meteorology, and sponsored by the Office of Naval Research, is aimed toward an explanation of the process. It appears that the pressure change, which produces the motion of migratory cyclones and anticyclones, can be attributed to the circulation around the pressure system in a field of temperature contrast, in the lower part of the atmosphere. Current emphasis is being placed upon the more important meteorological problems in the pressure field.

Even though the analysis of meteorological data has played an important role in the research program, it must be emphasized that meteorological theory and physical reasoning have guided the program. Equations which relate temperature, wind, and pressure changes have been utilized to provide data on changing atmospheric patterns.

It is hoped that this research will lead to a better understanding of the pressure-change mechanism and, to improved techniques for predicting weather.

Dynamic Performance

SAFE, relatively inexpensive, and rapid techniques for determining the dynamic performance of mechanical systems and components have been recently developed in the Instrumentation Laboratory of the Institute's Department of Aeronautical Engineering. The techniques, which overcome certain difficulties of other testing methods, were first applied to airplanes in flight. Exceedingly important in enabling the dynamic performance characteristics of airplanes to be obtained from measurements made in flight, the methods have been applied to the dynamic performance testing of other systems as well.

In one kind of test, using the frequency-response technique, the response of the airplane is determined from applied displacements of the elevator, rudder, and aileron. These control surfaces are oscillated sinusoidally, and from the linear and angular responses of the airplane, recorded on oscillograph paper, the amplitude and phase relationships between the input control displacement and the output linear and angular motions of the airplane can be determined. The results of such a frequency-response test were found to agree reasonably well with the performance predicted by theoretical methods. The frequency-response technique, using sinusoidal control displacements, required two hours' flying time for one condition of air speed, altitude, and center of gravity location.

Another technique, called the pulse method, considerably shortens the time required to make a test of dynamic performance. In this method, the pilot produces a sudden shock or jerk in the operation of the airplane which had previously been flying normally at equilibrium conditions. The transient condition, initiated by the pilot, is not sufficient to do damage to the airplane, but is sufficient to set up the fundamental motions which are characteristic of the airplane under test. By means of recording instruments placed on various portions of the airplane, the dynamic response of the airplane to such disturbances can be measured while the airplane is in flight, and the resulting displacements are recorded against time. Records of such measurements are analyzed in the laboratory after the test flight.

The performance function of the system under test – an airplane in the case under discussion – is the ratio of the output response (that is, the linear and angular motion of the airplane measured on an oscillograph) to the input response (that is, the disturbance inflicted on the system by the pilot in setting up a transient disturbance in the manner outlined above) and may be expressed in terms of amplitude and phase plots as a function of frequency. The pulse technique yields the performance function of the airplane over the useful frequency range from a single test. Recording of the test data involves only amplitude measurements with standard oscillographic instruments. The accuracy of the pulse technique is sufficient for all engineering requirements and results by this method are quickly obtained.

In general, the pulse technique for dynamic performance reduces test time, and increases the speed of extracting the performance function from the test data. In addition to determination of dynamic performance, the analytical section of the Instrumentation Laboratory, directed by Professor Charles S. Draper, '26, of the Department of Aeronautical Engineering, is continuing study in pulse techniques as a general method of analysis of linear and nonlinear systems.

The program of research reported here, to which Major Gerhardt C. Clementson, '48, United States Air Force, has made significant contribution, was part of the tracking control project directed by Robert C. Seamans, Jr., '42, Associate Professor of Aeronautical Engineering. The program was sponsored by the United States Air Force, which made available airplanes for the pulse and frequency-response tests.

To Speed Model Flight Tests

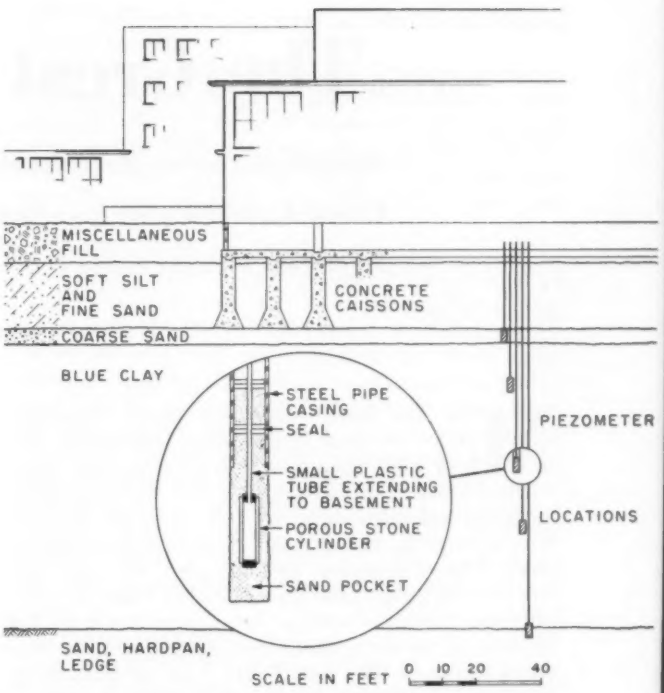
ONE of the greatest drawbacks in the use of dynamic models of aircraft has been the difficulty of quickly changing the basic mass and structural parameters of the model during the test program. Yet, such changes are necessary to arrive at the most desirable mass and elastic configuration. In the past, difficulties in making such changes have retarded the model program to such an extent that the aircraft, which the model is intended to represent, often reaches the flight stage before the model tests are completed. In such cases, the purpose of providing advance design data by means of models is defeated.

The technique of constructing and testing dynamic models which are similar to large aircraft has been developed to a high degree of precision at the Institute. The models, which are of such size as to be placed in existing wind tunnels, are constructed in such a manner as to reproduce, in detail, the elastic and inertial properties of the structure. Under the sponsorship of the Bureau of Aeronautics, Lawrence E. Beckley, '42, of the Division of Industrial Coöperation at M.I.T., has developed a sectional-type dynamic model which can be fabricated inexpensively and altered with little loss of time. By this scheme, a model wing can be constructed in several sections, each section of which has certain inertial and elastic properties. In addition, each section can be quickly removed and replaced by other sections with different properties. In this way, a complete structure composed of several components can be tested, and the influence of each component on the total behavior estimated. Such model versatility is especially useful in flutter studies, where a small change in the properties of a single component can have a profound effect on the flutter speed of the complete assembly.

Sinking Foundations

THE Institute's Charles Hayden Memorial Library is serving as a laboratory for studies aimed to bring about a better understanding of the settlement characteristics of structures, and to check current theories regarding the settling of buildings.

An important phase of the foundation investigation for all large buildings is a prediction of settlement, which is based on the foundation soil characteristics and the building loads. Settlement observation points are all too infrequently placed in the building in order to check the prediction. At the time construction was started at the Charles Hayden Memorial Library, the opportunity for such a check was recognized by the staff of the soil mechanics section of the Department of Civil and Sanitary Engineering. Through the efforts of Donald W. Taylor, '34, Associate Professor of Soil Mechanics, and William H. Mueser, '22, of the firm Moran, Proctor, Freeman and Mueser, consulting engineers on the job, 32 settlement observation points were placed throughout the basement of the building. In addition, 10 water pressure measuring devices (piezometers) were installed, under the supervision of Harl P. Aldrich, Jr., '47, an instructor in the Department of Civil Engineering, in the 90-foot-thick layer of Boston blue clay which underlies the building. This



Piezometers at different depths in clay below Institute's Hayden Library check theories on settling of buildings. Water level in the piezometers returns to its initial level as the water is squeezed from the clay while the buildings are settling.

is the first installation of its type in a buried clay stratum below a building. The figure, just above, shows a cross section through the foundation of the Charles Hayden Memorial Library. The location of five, and details of one, of the piezometers are indicated in it.

The research in connection with this installation has as its object the correlation of theoretical concepts with observed data in order to bring about a better understanding of the settlement characteristics of buildings founded on compressible clay layers. According to a widely held theory, the water in the voids of the foundation clay initially carries the total weight of the building. The piezometers record this phenomenon by a rise in the level of the water in the plastic tube (see figure), indicating an increase in water pressure in the clay. This excess water pressure decreases rapidly at first as the water is squeezed from the clay allowing the building to settle. Eventually the entire weight of the building will be transferred from the water to the soil grains and the settlement will be nearly complete.

According to Mr. Aldrich, the Hayden Library has now settled about one inch in the north wing and about one-half inch beneath the central court area. This settlement is somewhat less than was predicted. By way of comparison, in the first one and one-half years after the main Institute buildings were constructed, a maximum settlement of about three inches was recorded at Building 10. To date, that building has settled over eight inches, while Buildings 1 and 3, which have considerably better foundation conditions, have settled from one to four inches.

The Great Dream—I

Sometimes Feared, More Usually Hoped for, Always Taken for Granted, and Forever Receding Beyond the Reach of Explorers Was the Great Unknown Southland

By WILLY LEY

MUCH has been written in many languages about the great geographical discoveries and how and when they were made. But while many historians of science have told what the great geographical discoverers did find, there has been little emphasis on the question of what they hoped to find. A general answer to that query was provided once by the geographer Oskar Peschel when he wrote that the Spaniards went as far as there was gold, the Portuguese as far as there were spices, and the Russians as far as they found furs. Like all bons mots, Peschel's observation has its strong points as well as its weaknesses. The main strength of this particular characterization is that it holds true as far as it goes; its main weakness that it does not go far enough.

Not only did the Phoenicians and Egyptians, Greeks and Arabs, Irish and Vikings go exploring long before the Spaniards, Portuguese, and Russians had even become nations, but they also went exploring without such clear-cut economic aims. There were military situations to be explored, and claims for new lands to be settled; there were new nations with which to trade; and there were political journeys and missionary trips.

But through most of the history of exploration there is woven one continuous theme: the search for a gigantic continent, a continent which, it was thought, might easily be the largest of all. It was not only thought to be gigantic in size, but it also embodied all the hopes and all the wishes there were in existence. Men of letters of all nations thought about it and sang its praise. However, the long coast line of that continent on which to land was many a sailor's dream — always remained a dream. Whenever somebody thought that he had reached it, it dissolved like a vision, receded from the prow of the ship into uncharted distances and into the blue mist cloaking the horizon of faraway seas. The name that was later given to that fabulous continent was *Terra Australis Incognita*, the Unknown Southland. Its existence was sometimes feared, more usually hoped for, but always taken for granted.

The origin of the long-lived myth of that continent has been traced to two factors. One is very simply that our particular culture originated on the shores of the Mediterranean Sea and that that sea is landlocked. One might say that *Terra Australis* was a psychological recurrence of the northern shore of Africa. The second factor seems to have been a plain mistake.

At any event the story begins with the name of a great astronomer of classic antiquity, the Greek Hipparchus. Hipparchus knew that the earth was a sphere; in fact, he was the inventor of that net of degrees of latitude and longitude by which the location of a city or an island could be specified. Although Hipparchus was mainly an astronomer, he was a geographer, too. And he knew that the Mediterranean Sea and the Black Sea had no appreciable tides, while the Atlantic Ocean showed strong and regular tides. Then he heard that another astronomer, Seleukos, the Babylonian, had taught that the Indian Ocean was without tides. That statement was wrong, but Hipparchus could not know this. The obvious conclusion was that the Indian Ocean, too, was a landlocked sea. This being the case, it had to have a southern shore. The land was still unknown, but it had to be there. In fact there was a report around about just such a coast, of uncertain extent and position. It might be the North Cape of the unknown southern continent. Actually, that coast was a portion of the coast of Ceylon, but in about 150 B.C. it was not known with certainty that Ceylon, called Taprobane, was an island. At least, it was not known to Hipparchus.

The idea of a southern continent, of a repetition of the conditions around the Mediterranean, must have had a strong appeal, because it was well developed when the next important classical astronomer appeared, during the Second Century, almost precisely 300 years after Hipparchus. He was Ptolemy, or, as he should be called in order to avoid confusion with the Ptolemies of Egypt: Claudius Ptolemaeus. In many respects he was the direct successor of Hipparchus, continuing and rounding out his work in astronomical matters. In geographical matters he was the first man to produce a map of the world. His map dominated the conceptions of the classical world, and did so again after it had been republished in 1482 when new discoveries caused a great upsurge of interest in geographical knowledge.

On this map Africa and Asia dominate the scene and very little sea appears on it. The Atlantic Ocean appears as the western boundary of Africa from the Pillars of Hercules down to the equator, then Africa spreads westward to the rim of the map. In the north, that same Atlantic reaches around Europe, with England, Ireland, and Scandinavia drawn in as islands.

In the east, Asia fills the whole map; in fact, it is cut off by the map's border. It was anybody's guess

how far it extended in the east. The question of how far it extended to the north was left open, too. The southern end of Asia is, of course, India, somewhat incorrectly drawn. Taprobane now appears as an island, in the position of Ceylon, but much too large. Roman ships had sailed the Indian Ocean by then, and the coast of the Unknown Southland had receded for the first time.

But *Terra Australis Incognita* was there, making the Indian Ocean a second, though larger, Mediterranean. Asia, as has been said, was cut off by the border of the map, but close to the rim, the Indian Coast, — just east of something looking like the Malay Peninsula — made a sharp turn southward across the equator, to be met, say 20 degrees south of the equator, by the endless East-West Coast of *Terra Australis Incognita.*

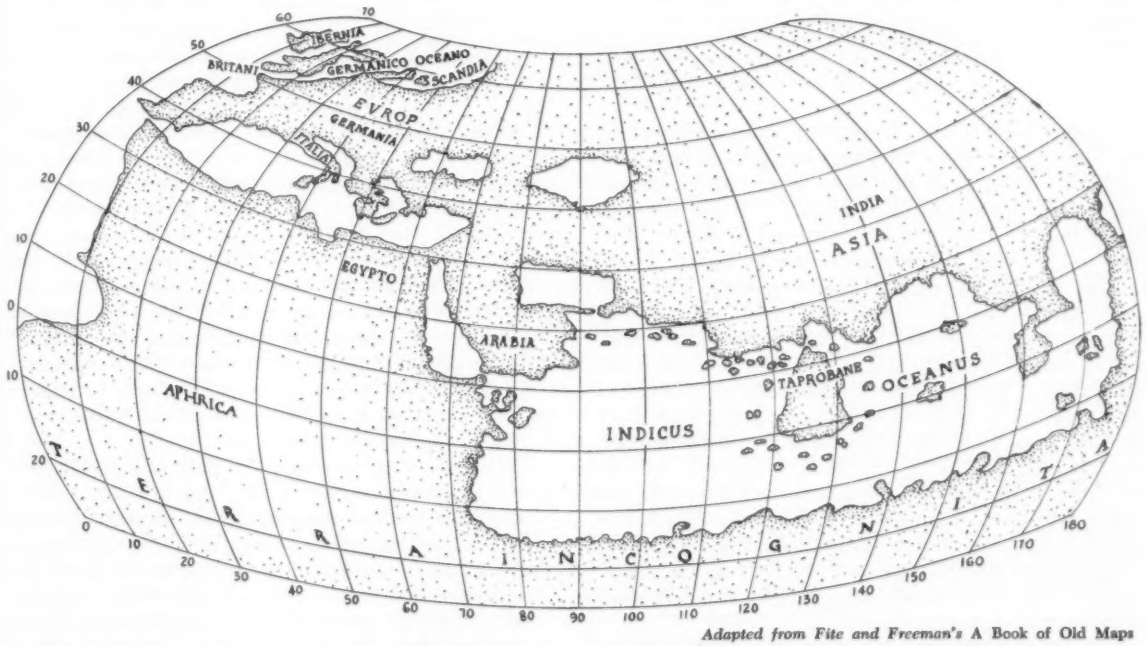
Terra Australis began in the west at Africa's East Coast. That East Coast had been explored, say to the latitude of Zanzibar. There is actually a slight easterly projection of the African continent near Dar es Salaam, as can be seen on any modern map. In reality, the African Coast then turns south again; on Ptolemaeus' map it did not. It went on and on, in a magnificent sweeping arc which joined what we now call the Malay Archipelago. That, too, was thought to be solid land, naturally establishing an eastern boundary for the Indian Ocean and a connection with Asia.

The map does not show it too clearly, but the Atlantic Ocean was taken to be definitely a northern sea. The whole concept is quite unmistakable: Africa itself is nothing but a gigantic northern promontory of *Terra Australis.*

The most amazing fact about this map is not the daring (to put it mildly) with which unknown territory was filled in by solid masses of land; the most amazing fact is that this map already preferred the results of theory to factual reports. Ptolemaeus must have known that long before his time a party had rounded Africa.

The facts of the case are these: The Egyptian, Pharaoh Necho, seems to have pondered the fact that his country bordered two seas: the Mediterranean in the north, and the Red Sea in the east. Unfortunately these two seas were not connected, but the Pharaoh thought that a connection which did not exist, could be made. He did not try to dig an early Suez Canal, directly from sea to sea, but he wanted a canal from the Nile to the Red Sea. His ships were probably small enough to sail the Nile upstream for some distance and reach the canal in that manner. For reasons not made clear, this work was suddenly interrupted. But Pharaoh Necho, or his advisers, thought of something else. He commissioned a group of Phoenicians to sail down the East Coast of Africa, around the southern end of the continent, if possible, then sail up the West Coast and return through the Pillars of Hercules (Gibraltar) to the Mediterranean, sailing east until they reached Egypt.

"And," quoting from Herodotus, "the Phoenicians set sail and sailed from the Indian Ocean into the Southern sea. When Fall came, they landed and tilled



Adapted from Fite and Freeman's A Book of Old Maps

Claudius Ptolemy, who lived in Alexandria during the Second Century, A.D., conceived the earth as a stationary sphere and proved the sphericity of the earth. As astronomer, mathematician, and geographer, his maps of the known portion of the world (along with two celebrated treatises, Magale Syntaxis, *or, to use its Arabic title,* Almagest, *and* Geographiké Syntaxis) *were the standard works on geography throughout the Middle Ages; they were not supplanted until the Sixteenth Century. Ptolemy underestimated the size of the earth (using 180,000 stadia as the circumference instead of the more precise value of 252,000 stadia of Eratosthenes — one stade of Eratosthenes being 159 meters) but his maps are more accurate than many later ones. The Atlantic and Indian Oceans are landlocked, and only the known half of the world is shown. The southern portion shows the expansive* Terra Incognita *or* Terra Australis. *Ptolemy's division of the world by parallels and meridians is still adhered to in modern cartography. It is interesting to compare this map with those shown on other pages of this article.*

Adapted from Encyclopedia Britannica, *14th edition*

Edrisi's map of the world, dated 1154, is usually shown with north at the bottom of the map, in accordance with the custom of Arabic map makers. Here, however, the map is turned around in its conventional manner so as to be more readily compared with other maps. Africa is shown as the great southland effectively blocking passage between Europe and the Orient. Edrisi's map indicated that access to the East might be obtained by sailing up the Sudan and Nubia (Nile) Rivers.

the soil wherever they happened to be and waited for the crops to ripen. After harvesting they continued with their journey so that they, after two years had passed by, proceeded during the third year through the Pillars of Hercules and returned to Egypt. And they told, which I cannot believe myself, but which others may, that during the rounding of Lybia (Africa) they had the sun to their right."

That one thing which Herodotus could not get himself to believe, that these men had seen the sun in the north, is just the one proof that they had actually been in waters far to the south of the equator. That story was disregarded all through antiquity, mostly because its reporter, Herodotus, doubted it himself. But he doubted it for only that one reason – precisely the same reason which forces us to accept it as truth. The point is that the doubts of the historian, Herodotus, hinged on an astronomical fact which should have convinced the astronomers, Hipparchus and Claudius Ptolemaeus, as it convinces us.

But both rejected this report of a trip around Africa, made during the years 596-594 B.C., almost precisely 2,000 years before the trip which is quoted in standard geographies as the first journey of that kind. Both also rejected the statement of an old *periplus* (sailing direction) that the Indian Ocean and the Atlantic Ocean meet south of Africa. They may have thought that this statement was based on the report of the trip undertaken by order of Pharaoh Necho – as may have been the case.

During the Roman Era the great geographical problem seems to have been simply dormant. Rome owned the Mediterranean, Rome dominated most of Europe, Rome had trade relations with the Far East. And Rome was essentially a land power; seas, to the Roman mind, seem to have been obstacles rather than trade routes.

Then the political picture changed and for a time the Arabs were the most important power on the Mediterranean. Their outstanding geographer, 1,000 years after Claudius Ptolemaeus, was El-Scherif Abú Abdallah Muhámed ben Edrisi. Of course he knew the map of Ptolemaeus and he had no reason to doubt it, except for minor details. Edrisi's map of the world was essentially an improved version of the older attempt. On Ptolemaeus' map, Africa's East Coast turned east at about the latitude of Zanzibar. On Edrisi's map, it does the same – a few dozen miles south of Aden. The whole East African Coast, fairly well known by then – with all its settlements, actual and invented rivers, actual and fictitious mountains and capes – all this turns out to be the North Coast of the great Southland. The eastern islands, especially Sumatra, flow together with Madagascar. One can describe it best by saying that Africa was turned sideways so that it formed a southern barrier for the Indian Ocean.

It is hard to explain just what conception of the world was held by the Christian nations north of the Mediterranean during the period of Arab supremacy. It is best to say that there were several beliefs, none actually prevailing, and none too definite. Most of those who formed a conception at all (a very large percentage seems to have been able to do without) accepted the sphericity of the earth.

What seems to have been the most acceptable idea of the shape of the earth is represented by the Macrobius map, made during the Tenth Century. It is circular and divided into five zones: the Northern Frigid, the Northern Temperate, the Tropical, the Southern Temperate, and the Southern Frigid Zones. Europe, Asia, and Africa are crowded into the Northern Frigid and Temperate Zones; only some southern parts of Africa and Asia project into the Tropical Zone. Most of the Tropical Zone was taken up by a wide sea, while everything else – the whole available space of the Southern Temperate and Frigid Zones – was occupied by the southern continent. *Temperata antipodum* says the map, adding cautiously *nobis incognita* (unknown to us).

Then, several important events took place. One was the introduction of the magnetic compass, shortly after 1100 A.D. We can be fairly certain now that it was invented in the North, somewhere along the shores of the North Sea. Suspicion naturally centers on the Vikings who were not only a seafaring nation, but who also lived in a country rich in iron ores, among them lodestones, natural magnets. The crusades were another important event. They did not add any new geographical knowledge, but they did stimulate interest in geography.

The third event was the return of the Polos from the Far East. That there were large and rich countries far to the east was not precisely new knowledge either, but Marco Polo's stories stirred the imagination, although contemporaries thought he exaggerated.

Just about a century after the return of the Polos, Prince Enrique of Portugal was born. History calls him Henry the Navigator, although he never made any long voyage himself, and very few short ones. But he caused others to do so. He founded what we would call a Nautical Academy. He saw to it that a collection of maps was made and that learned men devoted their time to geography.

Adapted from Wroth's Early Cartography of the Pacific

The Macrobius map showing the land of the antipodes. This Tenth Century circular map is built upon exposition of the Sixth-Century geographer, Aurelius Theodosius Macrobius, whose work, In Somnium Scipionis expositio *was first printed in the year 1483. The known world is divided into five zones, with clear indications of a southern unknown habitable region which is separated from the countries of Europe, Africa, and India by a large ocean.*

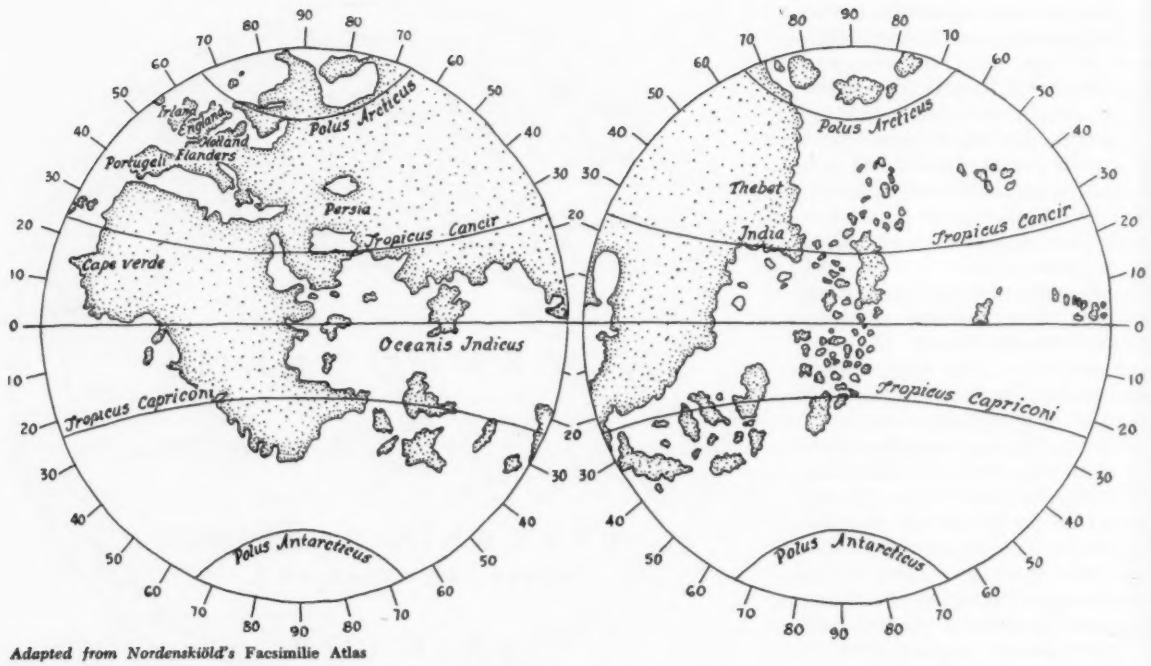
Naturally there was a practical purpose behind all this. The Polos had reached the Far East traveling overland. But a great deal of the return trip had been made by ship. If the East could be reached by ship, everything would suddenly look different. The trade could be carried on directly, without cheating intermediaries. Ship-borne goods would be far cheaper than goods carried by caravans. And finally, if the Christian nations, especially Portugal, could entrench themselves in the East they might, in the end, be able to attack the Mohammedans from the rear. The main question was whether the whole trip could be made by ship.

Essentially the choice was between the map of Ptolemaeus-Edrisi and the Macrobius map, or one like it. If Ptolemaeus-Edrisi were right, it could not be done. In order to sail on a landlocked sea one had to reach its shore first by overland travel. Here, unfortunately, the Mohammedans were in the way. If Macrobius was right, the problem was different. The *Terra Australis,* which prevented reaching the East by ship on Edrisi's map, existed, but it was a far southern continent with a wide tropical sea in between. All one had to do was to go south along the African shore until that tropical sea was reached, sail the length of that tropical sea, and arrive in the Indian Ocean.

The next problem was whether one could sail through that tropical sea. The older scholars said "no" with emphasis. Aristotle had said that the heat of the Tropical Zone must condense the water into a jelly-like substance, and that no ship could pass the *Mare pigrum.* The heat of the sun in these latitudes would be so terrible that it would ignite the wooden ships, after having struck dead their captains and crews. Nobody could live in these zones – which was the reason why the continent of the antipodes was marked *nobis incognita.* It was not only unknown to us, but it would not ever be known, since there was no way of passing the Torrid Zone.

It was a dilemma of the first order and the problem might have been dropped then and there if Edrisi's map had not provided another possibility. Edrisi had done something strange to the Nile. It did empty into the Mediterranean, as was well known, but farther upstream, in Nubia, the Nile divided and sent one long arm all the way across Africa to the Atlantic. That arm was the Gold River. This idea of Edrisi helped no end in Portuguese planning.

If one sailed straight south from Portugal one would, of course, reach Africa. Then one would follow the African Coast until the mouth of the alleged Gold River was reached, and then one could sail upstream across Africa. That still would not get the ships into the Indian Ocean, but the Mohammedans would be by-passed along a southern route and the ships would arrive in the fabulous kingdom of Prester John (then



Adapted from Nordenskiöld's Facsimilie Atlas

Martin Behaim's globe of 1492 records knowledge of the world just prior to the discoveries of Columbus and other Fifteenth-Century navigators. The absence of the continents of North and South America is conspicuous, and the Pacific Ocean is reduced in size. This supposed state of affairs encouraged explorers to reach Asia by sailing directly west from European ports.

thought to be Abyssinia). Prester John's kingdom bordered the Indian Ocean on the other side, and since it was a Christian kingdom the Christian Portuguese would have all the assistance they needed to finish the trip across Africa overland and build their ships on the Indian Ocean.

Fortified by this idea, the Portuguese started exploring. In 1419 they discovered (or probably rediscovered) Madeira; 15 years later they found the Canaries. The climate grew warm, even hot, but the luxuriant vegetation was reassuring. Maybe it would not be as bad as some philosophers had claimed. And while the water grew warm it did not show any noticeable "jellying." It was possible to go on, with the greatest of care, of course.

And they had reasons to be extra careful. In spite of their new instruments, including the magnetic compass, the sailors were in the habit of hugging the coast as much as possible. They felt safer within the sight of land. Doing just that was dangerous off the African coasts where shifting sandbanks suddenly appear and disappear again, where there are hidden cliffs, where coastal currents are often powerful, and where sandstorms from the interior reduce visibility to a matter of feet.

In 1441 Nuño Tristão reached Cabo Blanco (Port Étienne) at 21 degrees north. As the name indicates, it consists of white sands and is without vegetation. This looked ominous. Did the Torrid Zone, where no plants could exist, begin at this point? To their great relief the sailors saw people ashore; if people could live there it could not be too bad. But it is typical that Diniz Diaz who reached Africa's westernmost point four years later christened it Cabo Verde, the Green Cape, to reassure others by the very name of it that there was still vegetation. In 1447 they reached Sierra Leone – before the Portuguese, the Carthaginians had been there some 2,000 years, and Pharaoh Necho's hired Phoenicians may have landed there even earlier.

Prince Enrique, just before he died, in 1460, was rewarded by the report of one Diogo Gomez that a big river did come from the interior of Africa, the Niger.

After Prince Enrique's death there came a pause, well justified by political events. But Enrique's successor did not give up completely. He eliminated personal worry about the continuation of exploration and simultaneously increased the country's revenue by making an arrangement with the rich merchant Fernão Gomez which stipulated the following: Gomez had to pay a certain sum to the treasury and had to oblige himself to push exploration of the African Coast by 100 *leguas* (335 miles) every year in return for which he was granted trade monopoly along the Guinea Coast.

One year after this agreement was made, Gomez' captains passed the equator. One year after that, Fernão (Fernando) Po landed on the island which still bears his name. But then things slowed down some more. The Guinea Coast offered the same dangers to coast-hugging vessels as had been experienced earlier, even to a higher degree.

Still, after things had progressed to such an extent, anything that could happen would only cause a delay; cessation no longer threatened seriously. In 1485 a ship commanded by Diogo Cão (Cam) discovered the mouth of the Congo. Aboard was a young man from Nuremberg, who was to become one of Portugal's foremost geographers: Martin Behaim. They sailed upstream for some distance, wondering whether this was Edrisi's Gold River, but then turned back and pro-

ceeded southward along the coast, reaching a point 16 degrees south of the equator, near the present Mossamedes.

The Torrid Zone could be passed and Bartolomeu Diaz was sent out to find out how far Africa extended to the south. He landed near the present Swakopmund, then pressed on. The coast again showed a tendency to turn in an easterly direction, but Diaz could not follow it as closely as he wanted to, because a sudden storm blew his ships past the southern cape which Diaz called *Cabo Tormentoso*, the "Cape of Storms." He did not go on. His men threatened mutiny, and the captain himself was frightened. He returned to Portugal in 1487, announcing that Africa did have a southern end, the Cape of Storms, where he had feared to be wrecked.

In Portugal they thought differently about this report, not having undergone Diaz' experiences. Africa did have a southern end; that was one important piece of good news. The projection westward did not exist; even if there was a *Terra Australis* it might be possible to find a canal through it into the Indian Ocean. Martin Behaim made a globe on which things were shown just this way. Africa did have a long projection eastward from its southern end, but it failed to landlock the Indian Ocean completely. One could thread one's way in, between the African land and the large East Indian (Malayan) Islands. If things were like that, then everything was fine. The southern end of Africa was much farther away than had been hoped, but at least it existed, and the tropical seas could be sailed. There was good hope that India could still be reached.

Consequently Diaz' name of Cape of Storms was rejected and Cape of Good Hope substituted. That it was not actually Africa's southernmost point (that is, Cape Agulhas, east of the Cape of Good Hope) was only of academic interest. Ten years after Diaz' return, Vasco da Gama rounded Africa and finally arrived in India.

Ptolemaeus' *Terra Australis* had been expelled from the map. Or so one should think. True, Martin Behaim's eastern projection of Africa had to be erased from the map too, since Vasco da Gama had sailed through it. But all this did not mean that *Terra Australis* did not exist. It merely meant that Ptolemaeus had erred in thinking that Africa was part of *Terra Australis*. If somebody sailed southward from the Cape of Good Hope one would find it. Sailors had just stuck to the coast line too closely as they always did.

Nobody went searching at once. Portugal was, after all, interested in business relations and that meant India. At the moment it was far more important to consolidate the spice business than it was to chase *Terra Australis* which would not run away. The pleasure was spoiled mostly by the fact that one had rejected the pleas of a certain Italian, one Cristoforo Colombo "whom nobody knew." That Italian had gone to the king of Spain, and Spain, being envious (and with good reasons) had finally provided funds and three old caravels. Columbus reached what he thought to be Asia from the other side.

The Spaniards were elated. Those long trips around Africa were not needed; a three-weeks' sail to the west would suffice. That Colón, or Columbus, had first landed in an area which was not known was understandable. Obviously there were many more islands off Asia's eastern coast than overland travelers had been told about.

Five years after Columbus, Giovanni Caboto — by then anglicized as John Cabot — reached the "mainland of Asia" much farther north. Some geographers began to suspect a new continent, and then came a report that (three years after Cabot) Captain Pedro Alvares de Cabral had found still another shore. He had left with 13 ships to follow da Gama's route, had held off Africa too much and reached a different land: Brazil.

Cabral's accidental discovery caused speculation by the volume. He might have reached *Terra Australis* although he himself thought it was just a very large island. Of course there might be a group of very large islands there, a kind of counterpart to Java, Sumatra, and so on. Or, needless to say, it might be a continent,

(*Continued on page 324*)

Adapted from Nordenskiöld's Facsimilie Atlas

Southern Hemisphere of Schöner's globe of 1515 shows a large southland with bays, rivers, and lakes separated from Africa and South America by sizable stretches of water. For the most part, the region of Terra Australis *lies just outside the Arctic Circle and forms almost a closed ring around the Antarctic Ocean.*

The Ultimate Objective of Life

Perpetual Advance Is Most Rapid under Conditions Which Provide Maximum Individual Liberty and the Greatest Probability That Correct Decisions Will Be Found

By H. B. PHILLIPS

SOMETIMES we speak of one form of government or morals as higher, another form as lower. To give meaning to such expressions we must know the purpose of life. The system which more nearly accomplishes that purpose is the higher. What then is the objective of life, the achievement of which is to measure the success of any system of morals or of government?

This question is fundamental. There are people, for example, who sacrifice their lives for a system of government called communism: others sacrifice themselves just as freely for what is called democracy. When representatives of the two groups are brought together they cannot settle their differences by argument since they do not agree on the objective to be accomplished by government.

In considering such matters, we must distinguish immediate and ultimate objectives. There are many ways of reaching a given end. What is important is the position ultimately reached. This is well illustrated by the experiences of Russia and the United States in World War II. Many reporters noted that our soldiers did not know exactly what they were fighting for, and this confusion evidently stemmed from the fact that our responsible leaders did not have clear ideas on that subject. Some said we were fighting Hitler. The Russians were also fighting Hitler. Some said we were fighting to destroy Nazism. The Russians were also fighting Nazism. Some said we were fighting for our lives. In a much more imminent sense the Russians were also fighting for their lives. As General John R. Deane's book, *The Strange Alliance,** so clearly points out, the Russians regarded these, however, only as immediate objectives. They never forgot that their ultimate objective was the extension of their form of communism throughout the world. It is thus not surprising that there are now half a billion more communists than before World War II and fewer followers of democracy.

What then is the ultimate objective of life on earth? Many philosophers have thought the answer to be human happiness, or, as Beccaria expressed it, "the greatest happiness of the greatest number." Some religions have looked askance at happiness as an ethical objective, and in fact have considered physical pleasure as almost immoral. There is, however, much to be said in favor of happiness as an objective. Our senses of pleasure and pain have been developed in the long slow process of evolution. Those who enjoyed things that were beneficial found life easier. Those whose pleasures were harmful had greater difficulty. After ages, during which the race was barely able to survive, only those were left whose senses were best adapted to the conditions under which they lived. Thus, our sense of happiness is the best that nature could make it. Still there are fundamental reasons why human happiness should not be the ultimate objective of man.

A first reason stems from the origin of this sense through the process of evolution. This process adapts only to conditions which have existed for a long time and makes no provision for change of conditions. In some parts of the world, for example, the cattle forage includes poisonous plants. The local cattle have acquired a distaste for these plants and are uninjured. Cattle brought in from other countries eat these plants and die. Many of the conditions most helpful, as well as most harmful, to the human race have existed only for a few generations, a period much too short for human tastes to develop any powers of discrimination. We have every reason to believe that these changes will be much more rapid in the future. In a world subject to such perpetual change, human senses, however elevated, will always be obsolete to a considerable extent. A state of happiness based on obsolete values cannot furnish a satisfactory ultimate objective.

Another reason for rejecting human happiness as the objective is that it gives too great importance to the human species. Man is merely the creature which at the present moment is at the top of the animal scale. Morals should not depend on the stage of evolution. To see the absurdity of this, we need only apply this same criterion at an earlier period. At one time the highest form of life was represented by single-cell creatures of the type of the Protozoa: no one would now take the ultimate objective of life to be the happiness of Protozoa. A little later the giant lizards were supreme: no one would now consider the beauties of nature created for the enjoyment of lizards. Later still, mammals appeared about the size of rats: no one would now base a moral system on the promotion of the welfare of rats. And millions of years from now some superscientist, digging in the rubble of Manhattan for relics of a prehistoric creature called man, will certainly not think the marvels of this physical universe were provided for the happiness of such an animal as that.

Thus, however high we place the goal of life, it will ultimately be reached and passed. The highest forms in every age will already have attained a level

* New York: The Viking Press, 1947. $3.75.

beyond the wildest dreams of every preceding age. The only way to assign a permanent goal is to say that the purpose of life is just to keep advancing forever and ever.

This advance is progress, and since it produces things which never existed before, it is creation. According to this view, creation is not something which was accomplished billions of years ago but a process now going on, and which will always continue to go on. This external process of creation is what life is and what life is for.

This process has now, however, reached a critical stage. During all past ages development has occurred under conditions over which the living things had no control. Through increase in intelligence man is now reaching the point at which he can consciously influence progress. For the first time, good and evil have thus appeared in the world. An action which aids the long-term trend of progress is moral, or good. An action which opposes that long-term trend is immoral, or bad.

Here we have the real reason for those fundamental rules of conduct common to all the great moral codes. The purpose of these rules is efficiency. In all ages progress, so far as human beings can influence it, has come from the surplus of time and energy over that required to produce the necessities of life. Unnecessary killing is forbidden because it reduces the number of workers available to produce that surplus. Stealing is forbidden because it transfers resources from more productive to less productive control. Lying is forbidden because correct decisions require correct information. Individuals are adjured to love and not to hate because love promotes useful cooperation, whereas hate wastes time and effort through useless opposition.

Assuming then that the ultimate purpose of life is perpetual advance, the fundamental problem is to determine which way is forward. Since advance involves entry into the unknown, the proper direction is not suggested by experience. Also, reason is powerless, since reason does not suggest anything, but merely indicates whether a given suggestion is in accord with experience.

To handle this condition two methods have been tried. One is to adopt a single course of action determined by a dictator, by a majority, or by mere custom. Since the number of wrong courses vastly exceeds the number of right, this single choice is almost certain to be wrong. The other method is to provide diverse courses of action by leaving the choice to the smallest political units, and whenever possible letting each individual follow his own course. This results in a larger number of methods being tried with a proportionately larger probability that one will be correct. The greater success of the right method ultimately leads to its adoption. This is the only valid reason for liberty.

Unfortunately, individual liberty has nearly always been presented as merely a sentimental right, and all over the world there are simple-minded people who think it is not right to be wrong. If the way to heaven is known, they do not think it right to let people go to hell, and consequently do not believe in religious liberty. If correct information is available, they do not think it right that the public should be misled through incorrect information, and consequently they do not support freedom of speech or freedom of the press. If correct economic and business methods are known, they do not think it right that the public welfare should suffer through inferior methods, and consequently do not believe in freedom of enterprise. These simple-minded people are entirely correct. If right methods are known, they should be enforced, since liberty consists then merely in the privilege of being wrong. But if right methods are not known, individual liberty should prevail, since it provides the greatest probability that somebody will be right.

Thus we finally conclude that the ultimate objective of life is perpetual advance, that liberty is the condition under which advance is most rapid, and that in human affairs it is therefore the principal business of all social organizations to provide maximum individual liberty.

H. Armstrong Roberts

M.I.T. Photo

The proximity of Institute buildings and sailing facilities offers respite between classes.

Sailing at M.I.T.

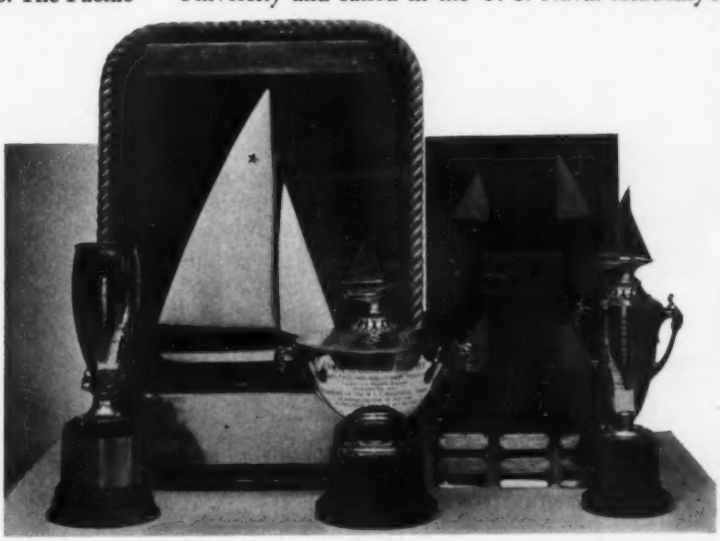
For the Decade and One-Half for Which Its Dinghy Fleet Has Sailed the Charles River, Intercollegiate Competition, Trophies, and Nautical Recreation Have Come to Technology

By WALTER C. WOOD

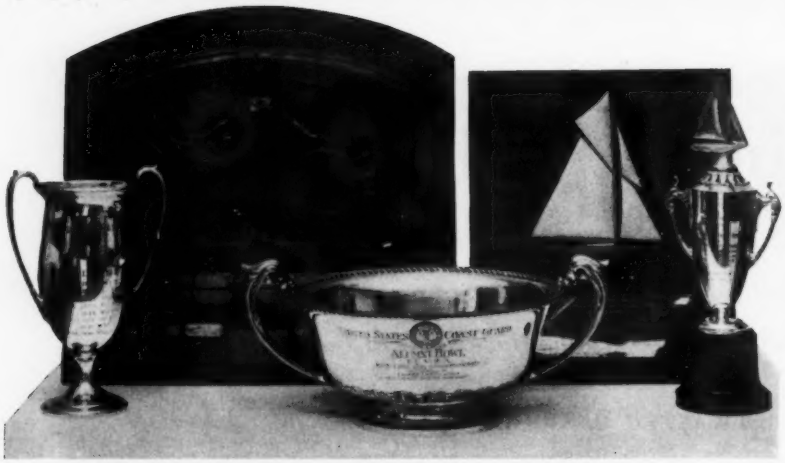
WHEN the sailing program was inaugurated at M.I.T. in the spring of 1936, the primary motivation was the desire to increase outdoor recreational activities for students at the Institute. The 15 years of growth of the M.I.T. Nautical Association demonstrate that this aim has been accomplished to a degree far in excess of that originally contemplated, and that many additional advantages have come to the Technology campus as a result of the happy introduction of a fleet of boats and a Sailing Pavilion on the Charles River.

First and most important of the subsidiary developments is the stimulation which has been given to collegiate sailing. The Technology program has been the model and inspiration for more than 100 college sailing clubs which now stretch from coast to coast, and extend even into Canada. These clubs are members of an over-all governing association called the Inter-Collegiate Yacht Racing Association of North America which is divided into four geographical districts: New England, Mid-Atlantic, Midwest, and Pacific Coast. These districts schedule their own regional races, arrange occasional intersectional regattas, and hold a national championship on a rotational basis in one of the districts each year. This spring, from June 19 to June 22, the New England district will conduct the National Dinghy Championship, with the M.I.T. Nautical Association serving as host club. The Pacific Coast teams of the University of California and Stanford University, with the University of Arizona as alternate, have already been selected to take part in this event on the Charles River. The other districts will choose their teams as a result of their spring regattas.

When it was introduced at M.I.T. in 1936, sailing had not been planned as a competitive sport. For many years, however, a spring race in boats larger than dinghies had formed the basis for a college sailing championship. It was only natural that colleges that had taken part in such races should seek to include M.I.T. in their competition as soon as dinghy sailing had been introduced at Technology. An invitation to take part was accepted and the M.I.T. team won by a small margin that first year; Technology's dinghy sailing has continued to dominate the field up to the present time. Out of 150 major regattas, which usually contained entries from 10 to 12 colleges, the M.I.T. teams have won 72 regattas; Brown University won 19; Harvard University, 18; Coast Guard Academy, 17; and Yale University, 16. The engineers have won six National Championships, while Yale has won three, Brown and Princeton, two each, and the Coast Guard Academy, one. This past year, the Technology team won nine of the 12 large events in which it was entered. Only the McMillan Trophy, won by Brown University and sailed in the U. S. Naval Academy's



Symbolizing victory five times in the fall of 1950, M.I.T. dinghy sailors have been privileged to add the trophies shown in the photograph at the right to their impressive collection. As a result of various championship races held in the autumn, the Institute is the proud possessor of: the Danmark Trophy shown in the left foreground; the winning trophy for the Erwin H. Schell Regatta (center foreground); and the Oberg Trophy which appears at the right in the foreground. The two plaques shown in the background are the James Pine Trophy at the left, and the Leonard Fowle Trophy at the right.



Pictured at the left are five trophies won by members of the Institute's Nautical Association during the spring of 1950. Glancing from left to right, in front, are: the Boston Dinghy Club Cup, the United States Coast Guard Alumni Bowl, and the Oberg Trophy. In the background, at left, is the Lucien Sharpe Trophy of Brown University, and to its right, the George Owen Trophy. Winning the Greater Boston Championship in the fall of 1950, as well as last spring, the Oberg Trophy continues to grace the M.I.T. Sailing Pavilion.

40-foot yawls, the National Championship for the Morss Bowl, won in California by Yale University, and the Jack Wood Trophy, taken by Harvard University, failed to find a haven on the Sailing Pavilion's trophy shelves. This continual domination of sailing among the colleges of the East has had a beneficial and exhilarating effect upon all sports at M.I.T.

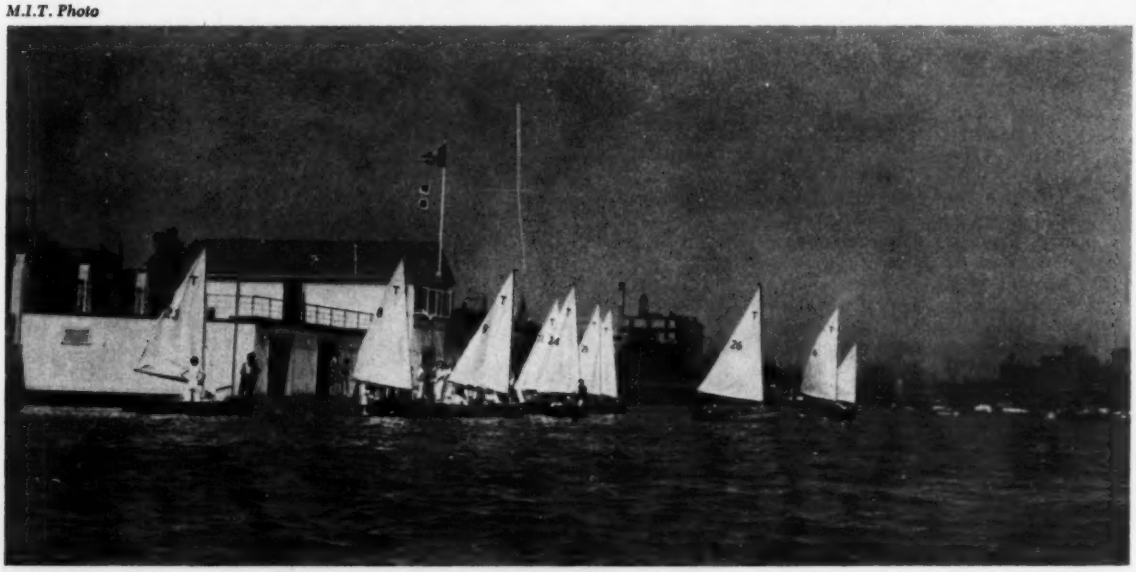
Sailing purely for recreation continues to constitute, by far, the largest function of the M.I.T. Nautical Association. The yearly membership averages 1,000 – of which 900 are students, and 100 are from the instructing staff or employees of the Institute. Annually, the membership averages between 14,000 and 15,000 man-hours of sailing, and, since the start of the program, more than 200,000 man-hours of recreational and competitive sailing have been recorded. More than 7,000 individuals have been members of the Nautical Association and comprise the alumni of the Institute's sailing program. Approximately 6,000 of these people learned their sailing at Technology, and many have continued to make it their favorite recreation after graduation, if they have been fortunate enough to live near water facilities.

The Institute's sailing program is greatly aided by having excellent sailing facilities literally at the doorstep of M.I.T. Because of the proximity of classroom and Charles River Basin, it is easily possible for a student to enjoy a sail during a single free hour between classes. Boats are deft'y launched, are rigged in a matter of five minutes, and, once rigged, they are left available at the dock for the inevitable crowd which gathers for sailing at the closing hours of the day. The required freshman sports program (which schedules hours of swimming, sailing, golf, tennis, volleyball, squash, badminton, and softball throughout the day) has helped the freshman to quickly become skilled in sailing techniques. The classes of approximately 40 are easier to work with than the larger groups, and sailing is much more enjoyable in the warm, sunny hours of midday than the cold, dark, windless hours of early evening. The sight of the Charles River Basin dotted with sails throughout the day has done much to dispel the fallacy that Technology students do not have time for play.

Sailing has given the Technology students valuable contacts with men in neighboring schools and yacht clubs. The teams of Boston College, Boston University, Northeastern University, and Harvard University use the M.I.T. sailing facilities at hours which do not conflict with Technology's use of the boats. The Harvard Naval Reserve Officers' Training Corps

(*Continued on page 321*)

M.I.T. Photo



THE INSTITUTE GAZETTE

PREPARED IN COLLABORATION WITH THE TECHNOLOGY NEWS SERVICE

New Dean Appointed

THE appointment of E. Francis Bowditch, headmaster of Lake Forest (Illinois) Academy, as dean of students at the Institute has been announced by James R. Killian, Jr., '26, President. Mr. Bowditch succeeds the late Everett Moore Baker, who died in an aircraft accident last August. In announcing Mr. Bowditch's appointment, Dr. Killian made the following remarks:

The dean of students at M.I.T. has authority and responsibility for overseeing all aspects of student welfare and for the Institute's relationships with student government and recognized activities, including athletics and fraternities. By advising and counseling with individual students and with student groups, he is in a position to promote fine morale, high standards of conduct, and the best possible conditions for personal development and educational achievement.

Mr. Bowditch was invited to fill this important post after a country-wide search. He brings to the office broad experience in the field of education and administration and great skill in working with young men.

Since Dean Baker's death, Dr. Dana L. Farnsworth, Medical Director of the Institute, has directed the activities of the Dean's Office. Mr. Bowditch's appointment becomes effective next July.

E. Francis Bowditch
Dean of Students at M.I.T.

Mr. Bowditch, who is 38 years old, was born in Framingham, Mass., and is the son of John P. and Alice B. Bowditch. He was educated at Milton Academy from which he was graduated *cum laude* in 1931 with a prize scholarship to enter Harvard. During his undergraduate career there he was president of the student council and served as second marshal of his class which was graduated in 1935. During his freshman and sophomore years he was a member of the track team. He is a member of the AD Club and the Hasty Pudding Club.

During his junior and senior years at Harvard, Mr. Bowditch taught at the Shady Hill School, and upon his graduation returned to Milton Academy where he taught Latin and English, and coached in football from 1935-1937. He left Milton to accept the appointment of assistant dean of freshmen at Harvard College and served in that position from 1937-1939 when he was appointed headmaster of the Park School in Indianapolis. He went to his present post as headmaster of Lake Forest Academy in 1941.

Mr. Bowditch has been a member of the Headmasters Association since 1942, and served two terms as president of the Midwest Preparatory Conference from 1943 to 1945. He was president of the Private Schools Association of the Central States from 1948-1949, and has been chairman of the National Council of Independent Schools and the National Preparatory School Committee.

Sheehan to Receive Chemical Award

JOHN C. SHEEHAN, Associate Professor of Chemistry at the Institute, who has made valuable contributions to fields as diverse as high explosives and life-saving drugs, will receive the $1,000 American Chemical Society Award in Pure Chemistry on April 2, during the Boston session of the Society's 119th national meeting, according to an announcement by N. Howell Furman, President of the Society and Head of the Chemistry Department at Princeton University.

Dr. Sheehan is best known for his share in developing the Bachmann process for preparing the high explosive RDX, and for his vital part in the research leading to the synthesis of penicillin. He will receive the award at a general assembly of the Society in the Hotel Statler. His award address will be presented on April 4 before the Society's Division of Organic Chemistry. Professor Sheehan's topic will be "The Synthesis of Substituted Penicillins and Simpler Structural Analogs." The American Chemical Society Award in Pure Chemistry is presented annually to recognize and encourage fundamental research carried out in North America by young men and women. It is financed by the professional chemical fraternity, Alpha Chi Sigma.

Class Reunions

As copy for the April issue is in preparation, word comes to The Review Office of June class-reunion plans. The majority of the class programs fall on dates just preceding or following Alumni Day on Monday, June 11. The Review is happy to list below information assembled to date on class get-togethers. Later details on class reunions may be obtained directly from the class secretaries.

1891 June 9. Dinner around noontime at The Country Club, Brookline, Mass.; Harry H. Young, reunion chairman, J. L. Hammett Company, 290 Main Street, Cambridge 42.

1896 June 8 and 9. New Ocean House, Swampscott, Mass. Dr. John A. Rockwell, reunion chairman, 24 Garden Street, Cambridge 38.

1901 50th reunion. June 8, participation in commencement activities; June 9 and 10, Oyster Harbors Club, Osterville, Mass.; June 11, special class table at Alumni Day luncheon in Du Pont Court. Philip W. Moore, reunion chairman, 1031 Fishers Lane, Hubbard Woods, Ill.

1906 June 12-14. Snow Inn, Harwichport, Mass. James W. Kidder, reunion chairman, 215 Crosby Street, Arlington 74, Mass.

1911 June 8-10, returning to Cambridge for Alumni Day, June 11. Snow Inn, Harwichport, Mass. Alexander W. Yereance, reunion chairman, 80 Federal Street, Room 704, Boston 10.

1916 June 8-10. Coonamessett Inn, North Falmouth (Cape Cod), Mass. Class get-together at Copley Plaza on June 11 in afternoon. Ralph A. Fletcher, reunion chairman, P. O. Box 71, West Chelmsford, Mass.

1921 June 8-10. Sheldon House, Pine Orchard, Conn. Class get-together at Copley Plaza on June 11 in the afternoon. Irving D. Jakobson, reunion chairman, Jakobson Shipyard, Inc., West End Avenue, Oyster Bay, Long Island, N. Y.

1926 25th reunion. June 9 and 10. Hotel Griswold, New London, Conn., returning to Cambridge for Alumni Day, June 11. Alfred H. Dolben, reunion chairman, 17 Bond Street, Reading, Mass.

1936 June 9 and 10. Weekapaug Inn, Westerly, R. I. Fletcher P. Thornton, Jr., reunion chairman, W. E. Green Corporation, Woolworth Building, New York 7, N.Y.

1941 June 9 and 10. Hotel Curtis, Lenox, Mass. D. Reid Weedon, Jr., reunion chairman, 4 Overlook Way, Winchester, Mass.

1946-2 June 9 and 10. Everett Moore Baker House, M.I.T. All members of Class of 1946 invited. Theodore P. Heuchling, reunion chairman, Servomechanisms Laboratory, Building 32, M.I.T., Cambridge 39.

1946-6 Donald A. Hurter, reunion chairman, 108 Vernon Street, Norwood, Mass. See listing above for Class of 1946-2, for date and place.

Please consult the class secretary or reunion chairman for later details.

Credit for the discovery of the RDX high-explosive process belongs to Werner E. Bachmann of the University of Michigan, but Dr. Sheehan worked with him on its development and made substantial contributions. The process, which was put into operation on a vast scale during World War II, is estimated to have saved the United States more than $200,000,000 in plant costs alone.

As a participant in the penicillin program at Merck and Company, Inc., Rahway, N.J., following his postdoctorate work at the University of Michigan, Dr. Sheehan had a large share in the devising of a practical synthesis of penicillamine, which is a key compound in the synthesis of penicillin itself. He likewise assisted in the syntheses of penicillic and isopenicillic acids – achievements which helped determine the structure of penicillin.

Dr. Sheehan joined the M.I.T. Faculty in 1946. Since then he has conducted investigations into other difficult problems in organic and biological chemistry. Born in Battle Creek, Mich., on September 23, 1915, Professor Sheehan obtained the B.S. degree in 1937 from Battle Creek College, and the M.S. in 1938 and the Ph.D. in 1941 from the University of Michigan. He worked as a postdoctorate research associate with Professor Bachmann at the University of Michigan under a contract with the National Defense Research Committee of the Office of Scientific Research and Development in 1941. He was employed as a research chemist by Merck and Company from 1941 to 1946. He was appointed assistant professor of chemistry at M.I.T. in 1946, and was promoted to the rank of associate professor in 1949.

Of Students and Geology

BIRTHDAYS and visitors from foreign lands came in for their share of attention at the 280th meeting of the Alumni Council which was held in the Campus Room of the Graduate House on Monday, February 26, 1951. John A. Lunn, '17, President of the Association, called the 114 members and guests to order at the close of dinner, and announced that Godfrey L. Cabot, '81, a member of the Council, was observing his 90th birthday that evening. President Lunn then called on H. E. Lobdell, '17, Executive Vice-president of the Association, to introduce Richard W. Plummer, '26, a member of the M.I.T. Club of Mexico, who extended a cordial invitation to Alumni to visit the club when in Mexico.

In order, the business portion of the meeting was taken over by reporting that 11 Faculty and Council members had visited four Technology Clubs between January 23 and February 15; in announcing nominations of the various districts for Alumni to serve on the National Nominating Committee; nominations of Class Representatives from classes whose numerals end in two or seven; and in reporting a very successful midwinter alumni meeting, as already recorded in the March issue of The Review.

As general chairman for Alumni Day, 1951, Allen Latham, Jr.,'30, named the following slate of committee personnel: *Banquet:* William H. Carlisle, Jr., '28, chairman, Stanley C. Dunning, '17, A. Robert Tonon, '22, David W. Skinner, '23, John J. Wilson, '29, Albert G. H. Dietz, '32, Laurance D. Sibley, '33, Russell Hastings, Jr., '34, Walter H. Farrell, '40; *Departmental*

Reunions: Julius A. Stratton, '23, chairman, Philip A. Stoddard, '40, Kenneth R. Wadleigh, '43; *Ladies' Events:* Mrs. Thomas P. Pitré, chairman, Mrs. Paul M. Chalmers, Mrs. Murray P. Horwood, '19, Mrs. Ralph T. Jope, Mrs. Henry B. Kane, Mrs. James R. Killian, Jr., Mrs. Robert M. Kimball; *Luncheon:* John M. Nalle, '20, chairman, Alan W. Burke, '20, Franklin K. Haven, '23, Clarence R. Westaway, '33, John L. Danforth, '40, Herbert H. Howell, '42, Otto E. Kirchner, Jr., '49; *Registration:* Wolcott A. Hokanson, Staff, chairman, G. Edward Nealand, '32, Robert E. Hewes, '43; *Transportation:* Emmons J. Whitcomb, '11, chairman, Malcolm S. Stevens, '34; *Stein Design:* Henry B. Kane, '24.

The President next introduced Professor B. Alden Thresher, '20, Director of Admissions, who spoke of the proposed extension of the Honorary Secretary system. In particular, he mentioned the several reasons that the Admissions Office needed to enlist more alumni assistance; the type of program which M.I.T. has followed in the past with the Honorary Secretaries; and the general principles of organizing an admissions-counselling program and its co-ordination with existing alumni activities.

President Lunn next presented the second speaker of the evening, Patrick M. Hurley, '40, Assistant Professor of Geology and Executive Officer of the Department. With the aid of charts Professor Hurley discussed the most recent theories of the origin of the earth with particular reference to the question of radioactive heating of the earth's interior. He discussed how the present thesis, that the earth is a large heat engine, contributes to a better understanding of the origin of mountain systems, and continents.

Rifle Team Contends for National Championship

THIS year Technology's varsity rifle team has proved itself to be one of the nation's all-time outstanding teams. Under the able tutelage of Master Sergeant James K. Brahe, an instructor in the Department of Military Science and Tactics, the riflemen have won every match of the season with the exception of one. Among its list of "scalps" the Engineers can count West Point, Annapolis, Cost Guard Academy, the University of Maryland, Duquesne, the University of Pittsburgh, New York University, Columbia, St. John's University, and all the schools in the New England College Rifle League. Technology's only defeat was from the University of Maryland, in a triangular match with Maryland and West Point at College Park, Md. In this contest, the Maryland team fired a team score of 1440, out of a possible 1500, while M.I.T. and West Point registered 1432 and 1424, respectively. Both M.I.T. and Maryland broke the old national record of 1430 in the highly contested match. However, Technology avenged both the defeat and the new record, for only a few days after the event, the Engineers tied the new record of 1440 in a match with St. John's University in Brooklyn, and subsequently defeated the Maryland five-man team in the District of Columbia Championship.

The high-scoring M.I.T. rifle team is led by Captain Herbert B. Voelcker, Jr., '51, All-American, who last year won the National Individual Championship and set a new national individual record. As well as captaining the rifle team, Mr. Voelcker has rowed for the past two years on the varsity 150-pound crew and is a member of Beta Theta Pi fraternity, Tau Beta Pi, Pi Tau Sigma, and Beaver Key. The other leading men on the Institute's rifle team include: Melville D. Bowers, '51, Allan B. Tanner, '52, Gene T. McCoy, '53, Arthur I. Auer, '52, Charles R. MacDonald, '51, John C. Champeny, '51, Malcolm D. Stuart, '51, Sarkis M. Zartarian, Jr., '52, and John F. Pasieka, '51. Mr. Bowers is a Navy veteran who transferred to M.I.T. last year from the University of Maryland. While at Maryland, Bowers shot on the 1949 national championship team and was an All-American the previous year. Mr. Tanner, who is also manager of the squad, together with fellow juniors Auer and Zartarian, has been shooting on the team ever since he was a freshman at the Institute two years ago. These three men, together with Mr. McCoy, a Marine veteran and a sophomore in Course XVII, should form the nucleus of another excellent team next year. To fill the vacancies which will be incurred by the graduation of seniors Voelcker, Bowers, Champeny, Stuart, MacDonald, and Pasieka, Coach Brahe has been grooming the freshman team into the best first-year squad Technology has had to date.

Along with participation in intercollegiate competition, the M.I.T. men have been entered in the Massachusetts Smallbore League for the past three years. This is a city-wide association of about 10 businessmen's rifle clubs which meet once a week for contests between the component teams. Though Technology has never been able to shoot its first team consistently in these week-night tourneys because of the pressure of school work, the scratch teams of freshmen, varsity, and junior varsity have gained valuable experience and have always ended in the upper bracket of the League. In connection with this phase of civilian shooting, the Institute's crack four-man team, composed of Bowers, Voelcker, Tanner, and MacDonald, recently won the New England William Randolph Hearst Citizens' Markmanship Competition.

The M.I.T. rifle team holds all-time shooting records established at the University of Pittsburgh, Duquesne University, Rutgers University, New York University, St. John's University, Fordham University, U. S. Military Academy, U. S. Coast Guard Academy, and of course M.I.T. It has broken every range record on which it has shot this year, except that of the University of Maryland.

With such a record of accomplishment, the team is eagerly anticipating the National Intercollegiate Rifle Match, sponsored by the National Rifle Association, which is to be held on Saturday, April 7. Some 200 colleges will compete in 12 sectional matches throughout the United States on that date. M.I.T. will play host to approximately 15 colleges in the New England section.

Unless Selective Service disrupts the student enrollment at M.I.T. the future prospects for the M.I.T. rifle team are excellent, even though the squad will lose the majority of its members this year at commencement. The combination of excellent coaching, Athletic Association and student body support should insure M.I.T. of a winning team in the future.

Earle F. Watts: 1897-1951

EARLE F. WATTS, Associate Professor of Drawing and Descriptive Geometry and Executive Officer of the Section of Graphics at M.I.T. died in Scituate, Mass., on March 10.

Professor Watts was born in Cambridge on October 16, 1897. He was educated in the public schools of Quincy, attended Thayer Academy, and was graduated from the Institute in 1920. Before joining the staff at M.I.T. as an instructor in drawing in 1925, Professor Watts had been a member of the faculty of the University of Missouri. In 1930 he was appointed assistant professor of drawing and descriptive geometry at M.I.T. and associate professor in 1944.

Meteorologic Weather Vane

AN important meeting of the Visiting Committee on the Department of Meteorology* was held on January 23, 1950. President Killian and Thomas K. Sherwood, '24, Dean of Engineering, represented the Administration, and Professors Henry G. Houghton, Jr., '27, and Hurd C. Willett, the Department. The Committee's report is summarized below:

The Committee feels that the staff of the Department of Meteorology is strong and energetic and that the student body is wholesomely abundant. At the present time there are approximately 30 undergraduates and 35 graduate students in the meteorological courses. To some members of the Committee, it appears that the present undergraduate curriculum in the Department prescribes too much specialization in meteorology, and that students should rather have more general physics and mathematics in preparation for the graduate work in Meteorology. It was suggested that the senior year, alone, might be reserved for the technical meteorological courses, but this point needs further consideration both by the Department and the M.I.T. Administration.

The widening of the field of activity of the properly trained meteorologist leads to the consideration of providing a joint training in Meteorology and some field of engineering. It would not be difficult, as pointed out by the meteorologists of the staff and of the Committee, to set up an attractive five-year course leading to the degree of meteorological engineer. Greater emphasis, the Committee believes, should be placed on studies and instruction in climatology. These matters need further investigation, both by the Department and the Administration. It was suggested that some of the advanced teaching might be in the nature of the case system instruction.

The principal employers of the holders of master's degrees in Meteorology are the government weather service and the air forces. The private air lines depend pretty well on the government meteorologists and do not employ many trained weather forecasters. Members of the Committee proposed that the employment of trained meteorologists by industrial concerns should be studied and encouraged. There are many industries, such as the power companies, the farm implement manufacturers, and the fruit and vegetable growers, for example, that could profitably employ experts in meteorology and climatology.

The Department of Meteorology is now working on five major research contracts, all of government origin: the application of radar to various meteorological problems, for the Signal Corps; the mechanism of the earth's atmospheric pressure changes, for the Office of Naval Research; studies of the general circulation of the atmosphere, for the Air Force; and, an additional contract extending the study of the general circulation to the Southern Hemisphere, for the Weather Bureau.

Finally, it was noted that there are only a few departments in America where graduate instruction in meteorology is offered, and none is as large and well equipped as is the Institute's meteorological organization. The Institute has a responsibility, therefore, for maintaining a high standard, for re-examining, from time to time, the content of the field, and for always striving toward new technical developments. The Committee feels that the Department is meeting these obligations exceedingly well.

*Members of this Committee for 1949-1950 were: Harlow Shapley, chairman, Franklin W. Hobbs, '89, Raymond Stevens, '17, Athelstan F. Spilhaus, '33, Harry Wexler, '39, Commander F. W. Reichelderfer, and Brigadier General Donald N. Yates.

Crew Has Bright Prospects

WITH six veterans of last season's crew in training on the Charles River, and a good season in retrospect, the M.I.T. crew has bright prospects for an enviable season in 1951. The six veteran crew members are: Donald A. Christiensen, '52; John C. Casson, '52; Paul G. Smith, '51, captain; Richard D. Semple, '52; Forest C. Monkman, Jr., '51; and Allen B. Fonda, '51, stroke.

The schedule for the 1951 spring season is as follows: April 21, Harvard and Boston University at M.I.T.; April 28, M.I.T. at Rutgers University; May 5, Harvard, Princeton, and M.I.T. in the Compton Cup Regatta at M.I.T.; May 19, Eastern Association of Rowing Colleges Spring Regatta at Princeton; June 16, Intercollegiate Rowing Association Regatta at Marietta, Ohio.

During the 1950 season, Technology's first race was rowed on the Charles River against Harvard and Boston University. Harvard won over M.I.T. by less than half a length, and Boston University came in third. The next race, the Compton Cup Regatta (named after Karl T. Compton, chairman of the M.I.T. Corporation), was held at Princeton, and Harvard again defeated M.I.T. by less than one foot – with Princeton third and Rutgers fourth. The Eastern Association of Rowing Colleges Sprint Regatta was the most important race of the regatta season and was held at Annapolis in late May. M.I.T. was finally able to defeat Harvard by four feet and in so doing won the regatta. Our post-season event was the Intercollegiate Rowing Association Regatta which was held at Marietta, Ohio. This race was held at a new location and was badly upset by a flash flood which practically ruined the regatta. However, we were able to salvage fifth place. One high light of the season was that Captain Robert C. Weber, '50, was nominated to the 1950 All-American Crew. James B. McMillin, '43, is head coach of crew at M.I.T.

(Continued on page 308)

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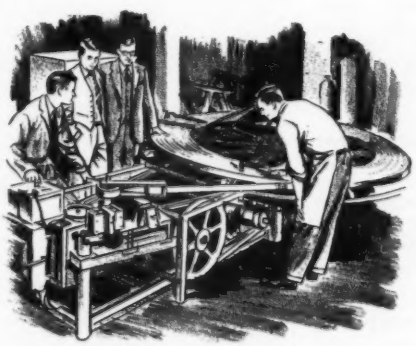
For many years Revere has been saying that "Copper is the metal of invention." Its numerous qualities, such as high electrical and heat conductivity, resistance to corrosion, easy fabrication into even the most complicated shapes, formability by hand with simple tools, make it attractive to designers and inventors, as well as to manufacturers. Now we would like to add that "Copper is the metal of science," because it is so essential to the operation of the most modern scientific devices.

Take the case of a cyclotron being built by a great Western university for special studies of the atom. The construction of this machine offers an unusual example of the use of copper not only in invention and science, but also education. An essential part of the project was the utilization of the university's own personnel, so far as possible, not only in design, but in construction and assembly. A large group of staff members, engineers, research assistants, electronic technicians, and machinists was formed. Included among the personnel were graduates and graduate students in physics.



The first major undertaking of the cyclotron group was the winding of the seven miles of Copper Bus Bar, supplied by Revere in soft temper, free from scale, rounded edges, to form the great coils for the electromagnet. The necessary winding machine for this work was built in the university shops, largely of surplus materials. It took four months to complete the coils and test each silver-brazed joint. Another important part of the cyclotron was shaped in the shop out of copper sheet, 4,000 pounds of it; the work on this is a story in itself. The heaviest part naturally is the special alloy steel core, weighing about 200 tons, forged in six pieces. Pole faces were machined parallel to a tolerance of 2½ thousandths of an inch, an excellent record on a piece of steel of such a large diameter (over five feet) as is required for the instrument. It is calculated that the magnetic force of attraction between the two poles will reach 160 tons when the current is flowing through the copper coils. We have spoken of copper's high electrical conductivity; another way to express it is that copper has low electrical resistance. The total resistance of the seven miles of Revere Copper in the coils is only one ohm, or less than a hundredth of the resistance of the glowing tungsten wire in a 100-watt light bulb. Tungsten has high resistance, which is why it becomes white hot; copper has low resistance or high conductivity, so that it can carry large amounts of power with minimum loss, little heating.

Eventually this cyclotron will add to man's knowledge of the atom. In the meantime, it has been a project of high educational value, and also an economical one; use of the university's own personnel and facilities cut the cost approximately in half. Revere is glad that it was asked to meet the high specifications drawn up for the copper, but it should also be recognized that many other firms supplied materials, such as the steel company, the makers of insulating paper and plastics, of cement, motor generators, electron tubes, and so on. Demands such as these for high quality demonstrate that American industry can meet challenges. So Revere suggests that the more complex and severe your requirements, no matter what the end product is to be, the more advisable it is for you to draw upon the knowledge and experience of suppliers. They can help not only on something as simple as a shoe, but on complicated machines, like an airplane—or an atom-smasher.

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THE INSTITUTE GAZETTE

(*Continued from page 306*)

Notabilia

THE significant support which the Institute's Faculty and staff have lent to the development of modern physics was again demonstrated in February when the 1951 annual meeting of the American Physical Society was held at Columbia University.

Professor John C. Slater, Head of the Department of Physics, delivered the Richtmyer Lecture on "The Electron Theory of Solids." In addition, two Technology professors – Sanborn C. Brown, 10-44, and Jerrold R. Zacharias – presided at technical sessions on "Discharge in Gases" and "Invited Papers in Nuclear Physics," respectively.

But a more accurate estimate of the role which the Institute plays in modern physics may be gleaned from the fact that 36 technical papers on the program were delivered by the contingent from Cambridge. Of a total program of 319 papers, the Institute contributed slightly more than 10 per cent. Other substantial contributors were: Columbia University, who presented 23 papers; Brookhaven National Laboratory, 18 papers; Yale University, 17 papers; Harvard University, 15; Cornell, 13; and the University of California, 12.

Presented by M.I.T. members were the following technical papers:

"Decay Processes Observed in a Multiple Plate Cloud Chamber at 10,600 Feet" by Herbert S. Bridge, Frank B. Harris, Jr., '49, and Bruno B. Rossi.

"Angular Distribution of the Ground-State Deuteron Peak from the $Be^{9}(p,d)Be^{8}$ Reaction" by John A. Harvey; "Energy Levels in Li^{7}" by Harry E. Gove and John A. Harvey.

"Energy Levels in F^{20} from the $F^{19}(d,p)F^{20}$ Reaction" by Hugh A. Watson, Douglas M. Van Patter, '49, and William W. Buechner, '35; "Energy Levels in Na^{24} from $Na^{23}(d,p)Na^{24}$" by Anthony Sperduto, '42, and William W. Buecher, '35; "Magnetic Analysis of the $Si^{30}(d,p)Si^{31}$ Reaction" by Douglas M. Van Patter, '49, Harald A. Enge, and William W. Buechner, '35; "The $Mn^{55}(p,n)Fe^{55}$ Neutron Spectrum" by Paul H. Stelson and William M. Preston.

"Absorption Measurements on the Neutral Radiation Producing Penetrating Showers" by H. W. Boehmer and Herbert S. Bridge.

"Recent Studies of Electron Collision Cross Sections at Low Energies" by Sanborn C. Brown, 10-44; "Neutron Capture Gamma-Rays" by Bernard Margolis; "Inelastic Scattering of Neutrons" by Walter Hauser, '50, and Herman Feshbach, '42.

"The Ionic Displacement in Barium Titanate" by Harald C. Schweinler; "$BaTiO_3$ Single-Domain Crystals at Low Temperature" by Walter J. Merz; "Optical and Electrical Measurements on Rutile Single Crystals" by Donald C. Cronemeyer.

"Van de Graaff Injector for Brookhaven Cosmotron" by R. G. Herb (University of Wisconsin), John G. Trump, '33, John L. Danforth, '40, and E. Alfred Burrill, '43; "Operation of the M.I.T. Rockefeller Electro-

(*Continued on page 310*)

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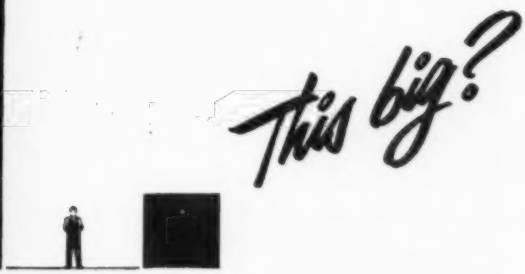

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(*Continued from page 308*)

static Generator" by William M. Preston and Clark Goodman, '40; "Effect of Ducts on the Attenuation of Neutrons and Gamma-Rays in the M.I.T. Cyclotron Shield" by John W. Crawford, Jr., 9-46, Edwin E. Kintner, 9-46, and Clark Goodman, '40.

"Plasma Oscillations in a Static Magnetic Field" by Eugene P. Gross.

"A Phenomenological Treatment of Photo-Meson Production from Deuterons" by Melvin Lax, '43 (Syracuse University), Herman Feshbach, '42, G. F. Chew (University of Illinois), and H. W. Lewis (University of California); "Photon-Meson Production from Deuterons" by M. L. Goldberger (University of Chicago), Felix M. H. Villars, and Herman Feshbach, '42.

"Positron Annihilation" by Martin Deutsch, '37; "The Microwave Spectra of the Deutero-Ammonias" by Max T. Weiss, '47, and Malcolm W. P. Strandberg, '48; "The Rotational Magnetic Moment of $^1\Sigma$-Polyatomic Molecules" by John R. Eshbach and Malcolm W. P. Strandberg, '48; "Centrifugal Distortion in Asymmetric Molecules, HDS" by Richard E. Hillger and Malcolm W. P. Strandberg, '48; "Microwave Spectrum of Ketene" by Horace R. Johnson, Julian G. Ingersoll, and Malcolm W. P. Strandberg, '48; "Microwave Absorption Spectrum of Oxygen" by Bajirao V. Gokhale and Malcolm W. P. Strandberg, '48.

"Resistance Minima in Metals" by Harold E. Rorschach, Jr., '49, and Melvin A. Herlin, '48; "Magnetic Dipole Interactions in Crystals Near Absolute Zero" by Morton B. Prince and Melvin A. Herlin, '48; "Pressure Variation of Second Sound Velocity in Helium II" by Robert D. Maurer and Melvin A. Herlin, '48.

"Optical Absorption and Photo-Conductivity in Amorphous and Hexagonal Selenium" by M. Alten Gilleo, '48.

"Beta-Gamma Angular Correlation in the Decay of Sb^{124}, I^{124}, and I^{120}" by Donald T. Stevenson, '50.

"Report on the Gaseous Electronics Conference of October, 1950" by William P. Allis, '23; "Annihilation of Swift Positrons" by James W. Shearer, 6-45, and Martin Deutsch, '37; "Radiation Loss of Electrons" by Lee M. Spetner and Joe S. Clark, '37.

"The Paramagnetic Spectrum of Ammonium Chrome Alum" by Arthur F. Kip, Renato Malvano, and Charles F. Davis, Jr.; "Nuclear Magnetic Moment Ratios of Isotopic Pairs" by Norman I. Adams, 3d, Thomas F. Wimett, 2-46, and Francis Bitter.

For Physical Fitness

THE well being of the Institute's students, Faculty, and staff, now numbering more than 10,000 persons, was the primary topic of discussion at the meeting of the Visiting Committee on the Medical Department*, held on March 6, 1950. In addition to the

(*Continued on page 312*)

* Members of this Committee for 1949-1950 were: Donald F. Carpenter, '22, chairman, Dr. James H. Means, '06, Harold Bugbee, '20, Dr. Egon E. Kattwinkel, '23, Dr. Marian Ropes Fielding, '26, Dr. Arlie V. Bock, and J. Willard Hayden.

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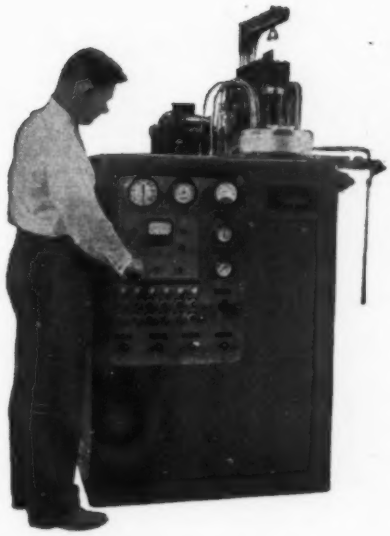

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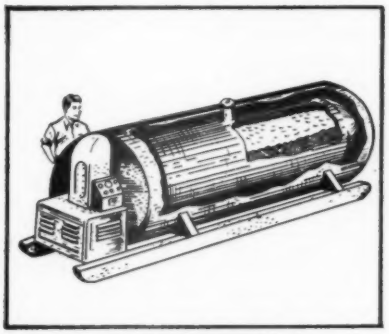

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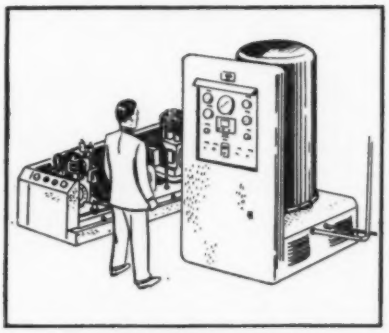

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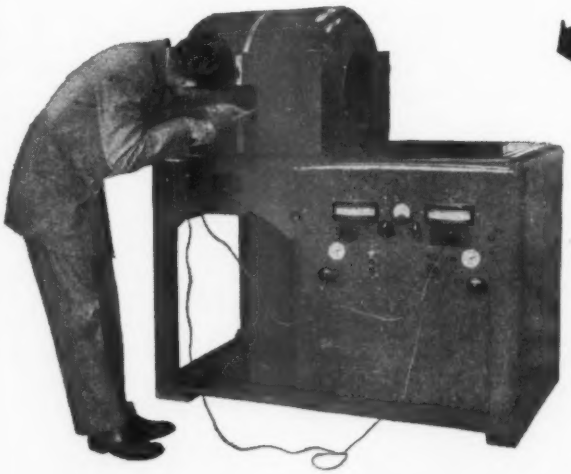

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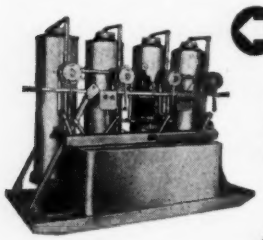

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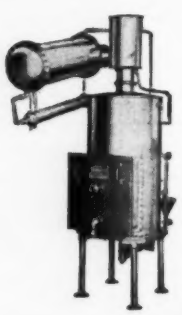

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THE INSTITUTE GAZETTE

(*Continued from page 310*)

Committee members present, Dr. Dana L. Farnsworth, Medical Director, Dr. John W. Chamberlain, '28, Associate Medical Director, and Dr. Harriet L. Hardy, Assistant Medical Director, were also present.

In a review of the year's activities, Dr. Farnsworth gave special reference to the financial policy of the Department. He expressed the idea that any further expansion of service by the Medical Department should be done only when such extension is financially self-supporting. This recommendation was made not only because economic conditions make it desirable, but also because it is psychologically desirable for the students to support services that are primarily for their own welfare.

Dr. Farnsworth also outlined a health insurance plan for students which was endorsed by the Committee and went into effect in the fall of this year. Under this plan, each student is enabled to budget his medical expenses at as low a cost as possible. For the payment of $9.00 per semester, the insuring agency will assume, with certain limitations, the cost of a room in the Homberg Infirmary or hospital up to $13 per day, medical and surgical care, and special charges up to $1,000 for each illness or injury, and up to $100 for repair of injury to sound, natural teeth. The plan is optional, but each student is charged for the insurance unless he signs a waiver as part of his registration procedure, stating that he does not desire to have it.

Dr. Hardy reported in detail on the work of the Occupational Medicine Service, organized as part of the Medical Department about two years ago. This service is for the special convenience and protection of employees, students, and others who may be exposed to health hazards in the course of their work. Special attention is paid to the prevention of illness or injury. The removal and control of hazards arising from research work, both with ordinary chemicals and with radioactive substances, are important parts of this program. The Committee recognizes the importance of the work of the Occupational Medicine Service but believes that the responsibility for the control of industrial hazards should lie primarily with the heads of departments, and that the Occupational Medicine Service should act in an advisory capacity and not assume full responsibility for carrying out its recommendations.

Dr. Farnsworth reported the establishment of a Safety Committee by the President, made up of 32 staff members and other employees. The Institute is divided into geographical areas, and in each area both the staff and employees have representation. The committee, under the chairmanship of Dr. Farnsworth, meets monthly for routine business and educational programs, and although it works very closely with the Occupational Medicine Service, it is not a part of the Medical Department.

The need for additional space for the Medical Department was discussed, since the Occupational Medicine Service is without suitable office space. In

(*Continued on page 314*)

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(*Continued from page 312*)

addition, offices are needed for about four other persons, including a psychiatrist, an internist, and any Fellows who may be in training. The addition of a fourth floor to the Homberg Infirmary would provide suitable space for this latter purpose. The Committee explored other possibilities without making specific recommendations. The Medical Department has been recently renovated, major repair of the ventilating system has been made, and a new record room and two new offices for secretaries have been obtained.

The Committee continues to feel the desirability of inaugurating a department of physiotherapy and recommends that such a service be established as soon as practical. Through the generosity of J. Willard Hayden, a new x-ray machine has been installed, thus completing the modernization of the X-ray Department at the Institute.

The Committee then studied means for providing the necessary space for the services that do not have adequate housing. It was unable to find suitable space and recommends that further study be made in this direction, since this is now the most urgent need confronting the Medical Department.

Professor Soderberg Honored

PROFESSOR C. RICHARD SODERBERG, Head of the Department of Mechanical Engineering at the Institute, returned in March from Sweden where he was awarded the honorary degree of doctor of technology by the Chalmers Institute of Technology, one of Europe's most distinguished technical institutions. Chalmers Institute of Technology was founded in 1830, beginning as a school of naval architecture and expanding to become an outstanding institution of higher learning. In recent years it has become one of the world's centers of important developments in communications theory.

Dr. Soderberg was graduated from Chalmers Institute in 1919, and the honorary degree which was awarded to him was the first of its rank to be given by the institution. Dr. Soderberg joined the staff of M.I.T. in 1938 and is widely known as an authority on turbine design.

Building Engineering Recommendations

THE Visiting Committee on the Department of Building Engineering and Construction* met at the Institute on April 25, 1950. All the members of the Committee were present, and President Killian and Thomas K. Sherwood, '24, Dean of Engineering, participated in the discussions of most of the items on the agenda.

(*Continued on page 316*)

* Members of this Committee for 1949-1950 were: C. George Dandrow, '22, chairman, Harry J. Carlson, '92, John H. Hession, '13, Harold Bugbee, '20, Miles N. Clair, '23, Lou R. Crandall, and Henry R. Shepley.

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THE INSTITUTE GAZETTE

(Continued from page 314)

Changes in curriculum which might be occasioned by the proposed increase in emphasis on humanities, closer liaison with the School of Architecture, departmental conferences, enrollment, and the status of various research projects were the principal items under consideration at the meeting. As a consequence of this meeting, the Committee formulated the following five recommendations to the Department and to the Administration of the Institute.

1. The Committee recommends that the Department examine very carefully the present curriculum and re-evaluate all phases of the program, in order to be ready to join the rest of the Institute in broadening the program of humanities in the event that such action is taken. At the same time, the Department is cautioned not to impair the soundness of the basic technological training given the students, because this training is difficult, if not impossible, to obtain after graduation. In this connection, the Committee appreciates very much the explanations of the Institute's thinking on the subject of a broadened curriculum as set forth by President Killian and Dean Sherwood.

2. The Committee recommends that the Department continue to strengthen its policy of providing the students with basic training in such related fields as electrical engineering and heat engineering, rather

(Continued on page 318)

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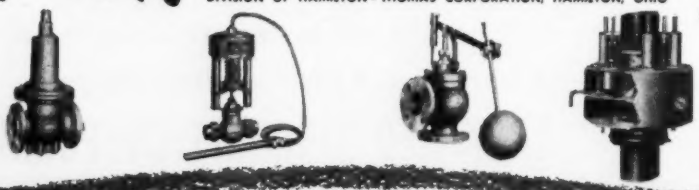

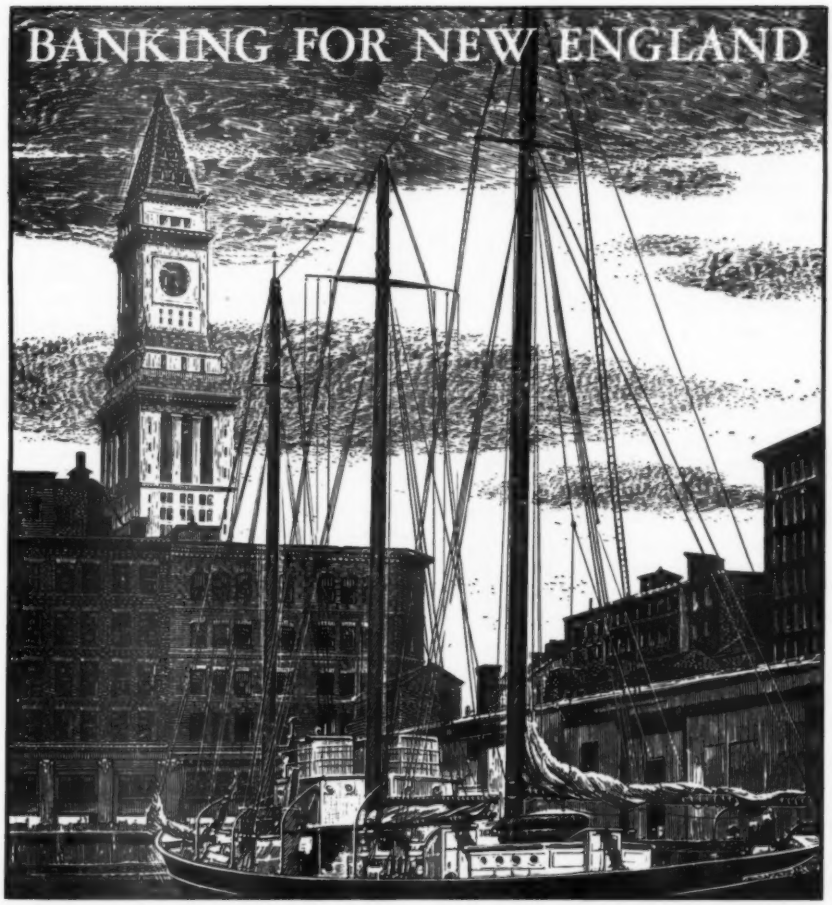

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THE INSTITUTE GAZETTE

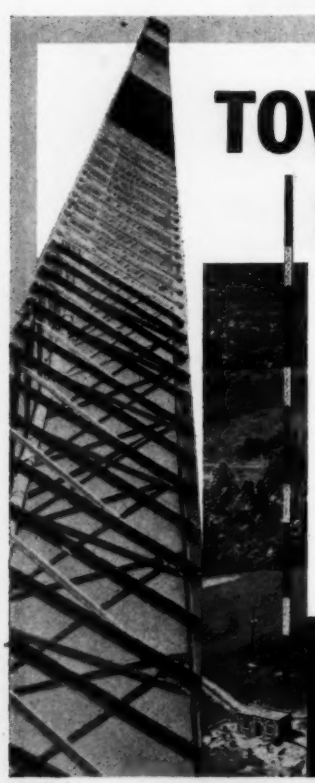
(*Continued from page 316*)

than providing informative courses in existing practice with respect to equipment of buildings. The Committee recommends that, if at all possible, the program of fundamentals of engineering be extended to include work in fluid mechanics.

3. The Committee strongly recommends that appropriate action be taken to develop closer liaison among the students in the School of Architecture and in the Department of Building Engineering and Construction. It seems best to attempt such liaison in the third and fourth years when the students in each Department have sufficient background to permit mutually profitable co-operative problems to be undertaken. The interchange of ideas and points of view which would result should measurably broaden the backgrounds of each group of students. Such co-operation is deemed to be a better way to acquaint the students in building with the problems and methods of architectural planning than would any short course in planning principles.

4. The Committee recommends that the program of departmental conferences, to which speakers of recognized authority in the various phases of construction and related fields are invited, be continued and strengthened and that the Administration of the Institute assist in the furtherance of the program. Summer

(*Concluded on page 320*)



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THE INSTITUTE GAZETTE

(Concluded from page 318)

conferences, such as the Conference on Mechanical Properties of Plastics, largely developed as a consequence of the research program in mechanical properties of plastics, should be encouraged and extended.

5. The Committee reviewed the various research projects being conducted by the Department and the prospects of continuance of outside support of these projects. Particular interest was expressed in the plastics and masonry materials research programs. The Committee deemed these to be of such basic and long-range value that every effort should be made to assure their continuance.

Theodore Roosevelt's Letters

SIGNIFICANT research in the field of political science continues at the Institute, as the first two of eight projected volumes of *The Letters of Theodore Roosevelt* are announced for publication this spring. Since 1948, the Roosevelt Research Project has been working at M.I.T. under the direction of Elting E. Morison, Associate Professor of English. The Roosevelt Memorial Association and Harvard University Press have joined Technology in providing funds, space, equipment, and research aids for this work. Although a research project of this type is somewhat unusual for an institute of technology, it is in keeping with the Institute's expanded educational program in political science, economics, and international relations in the School of Humanities and Social Studies.

Guide for Visitors

ALUMNI who have not visited the Institute for several years will find that many changes have transpired, while those whose last visit to Technology antedates the beginning of World War II may find some difficulty in recognizing many buildings long in regular use.

The Institute's expanded size also frequently leaves the visitor in bewilderment. To meet the need for a compact, convenient means of directing strangers to the desired spot on the Institute's 100-acre campus, *A Visitor's Guide* has recently been published. The center spread contains a map showing M.I.T. property which now extends along the Charles River Basin for

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more than a mile – from the Crew Boat House near the Cottage Farm Bridge (recently renamed Boston University Bridge) to the recently acquired Lever House near Kendall Square. The map shows the complete grouping of academic buildings, living quarters, recreational facilities and playing fields. The *Guide* also contains information regarding the Information Office, the Institute's library system, museums, laboratories, student housing, athletic facilities, and Walker Memorial.

SAILING AT M.I.T.

(*Continued from page 302*)

makes use of the M.I.T. facilities to introduce their students to the water. The contacts thus made between Technology students and other institutions in the Boston area have done much to improve the relationships between these schools. With its easy camaraderie, sailing tends to engender lasting and close friendships between the competitors to a degree not found in any other field of sport.

The problem of teaching several hundred novice sailors each year has been solved by evolving an organized program of instruction in which qualified volunteer students assist in teaching. The teaching experience obtained by the volunteer instructors makes them much sought after by private yacht clubs all over the East. Each year, the number of opportunities for such instructors to become junior instructors in private clubs exceeds the number of persons available. Summer jobs in sailing instruction offer many students an opportunity for a healthy outdoor life and an opportunity to put into practice their qualities of leadership and organization.

Fifteen years of hard sailing, and the inevitable minor accidents which occur when novices learn to sail have taken their toll, and the original Technology fleet is nearing the end of its useful life. The need for a new fleet has long been recognized by the Administration of the Institute, but action has been delayed until the more pressing needs of the Development Program for increased academic facilities could be met. With the successful completion of the Development Committee's work, it is our hope that sailing will receive financial help toward a new fleet from the many sailing alumni who have enjoyed so many days of sailing in the sport they have loved so well.

The high cost of wooden boat construction, and the lack of skilled workmen in this trade at the present time, indicate that a new method of construction

(*Concluded on page 322*)

William H. Coburn, '11 William F. Dean, '17

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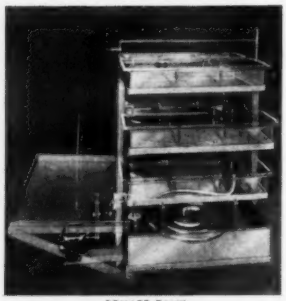

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SAILING AT M.I.T.

(*Concluded from page 321*)

should be used in such a new fleet. Fiberglas and plastic have been combined to make a very durable and satisfactory small boat which would be suitable for use in such a fleet. One such boat has been made and tried out at Technology with very satisfactory results. Hulls from plastic-impregnated Fiberglas are uniform, durable, and easily maintained at low cost. Initial cost of boats made from this material is lower than that for boats of similar size but made of wood. None of the colleges have a fleet of boats made of Fiberglas, but this new material will probably be used extensively in any new fleets which come into being.

During World War II, restrictions on travel made the sailing program more popular than ever. At the same time, the Institute's enlarged population from the Army, Navy, Chemical Warfare Service, and a large force of the Division of Industrial Coöperation increased the number of persons who found relaxation in dinghy sailing. While the intensive three-term program at M.I.T. was in force, the use of the boats increased from approximately 14,000 hours to 20,000 hours yearly. We are now entering a period similar to that of World War II, in which use of the Technology fleet is increasing rapidly. To help meet the recreational needs of the Institute's students, Faculty, and staff, under the strenuous program of teaching and research which is required today, it is essential that Technology's fleet be strengthened with new boats which should once more admirably serve our needs in the years ahead.

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TO M.I.T. MEN

In 1917 Walker Memorial Building was opened, a gift from Alumni for the welfare of M.I.T. students. In addition to including offices for student activities and serving as a student social center, this building houses the dining service.

In 1949–50 nearly one million meals were served to staff and students and 57 dances, receptions and balls were held in Morss Hall. Morss Hall seats approximately 500 people. Thus, each chair served 2,000 people per year or 5.5 persons per day. We thank the Alumni for making these services possible.

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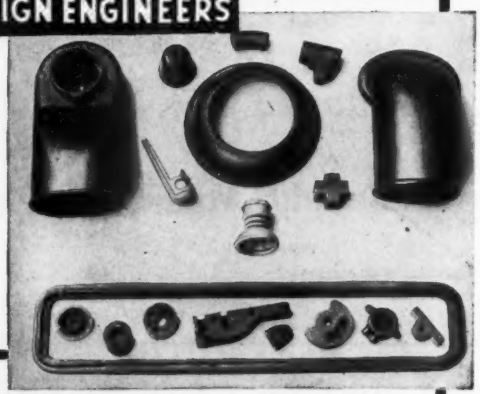

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THE GREAT DREAM

(*Continued from page 297*)

Terra Australis. If it were a continent, one would have to find out whether it had a southern end. With orders to that effect, Fernão Magalhães (Magellan, to give the English version of his name) left Europe in 1519. For a short while he was fooled by the La Plata River which is large enough to look like an arm of the sea. But the mistake was realized quickly and Magellan continued south, until he found the strait which now bears his name. Beyond that strait came open sea, an exceptionally large open sea. Magellan crossed it under great hardships. He himself found death in the Philippines, but his ships completed the first circumnavigation of the globe.

Brazil, or South America, was not *Terra Australis* and Magellan had proved – oh no, Magellan had only proved what another mathematician and geographer of Nuremberg had prophesied in 1515, four years before Magellan left port. That mathematician, Johannes Schöner, had made a beautiful globe in that year, a globe on which all the latest discoveries were shown. There was Africa with a free tip in the south, showing just how Vasco da Gama had sailed around it. There were indications of North America, and there was South America, somewhat small, but correct in outline as far as one could tell then. Like Africa, it had a free southern tip, but while the sea below Africa was comparatively broad, there was only a small channel south of South America. And beyond the channel loomed *Terra Australis* in enormous size, well equipped with bays and capes, mountains and rivers.

Schöner had, by way of his globe, predicted that one would be able to sail around South America's southern tip. The Portuguese seaman, Magellan, sailing for the king of Spain, had actually done it. But he himself had reported that conditions were not the same as at the southern tip of Africa: *there* was a wide open sea. *Here* Magellan had sailed with great danger through a comparatively narrow channel. To his left he had seen other land, and had seen it clearly enough to name it even. It was Tierra del Fuego –

(*Concluded on page 326*)

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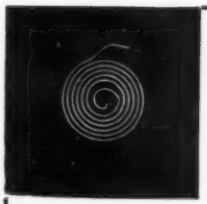

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THE GREAT DREAM

(Concluded from page 324)

certainly a northern promontory of *Terra Australis* which reached much farther north elsewhere.

While Magellan, sailing for Spain, had put one corner of *Terra Australis* on the map, Dom Jorge de Menezes, journeying for Portugal, provided another one. In 1526 a storm had driven him east from Borneo and he had seen a coast where a strange black race of people, very unlike the Malayans, was living. Nothing was done about that coast then, but it was rediscovered 19 years later by a Spanish vessel under Captain Inigo Ortiz de Retes, who fought a fierce battle with the long war canoes of these black people. He saw high mountains beyond the coast line, and he called the coast New Guinea, probably because the Papuans reminded him of the African Negroes. In Europe the name was given a different meaning. The Guinea Coast of Africa was, naturally, the coast of a continent. The New Guinea Coast was a continental coast, too — the continent being *Terra Australis.*

Part II of Mr. Ley's article will appear in the May Review. In his conclusion, the author recounts the search for Terra Australis *which continued through the Sixteenth Century into the Eighteenth, when Captain Cook dispelled the dream of the Great Unknown Southland.—Ed.*

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What GENERAL ELECTRIC People Are Saying

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Apparatus Department

JET NOISE: Since its inception the noise problem associated with turbojets has received considerable attention from the public as well as from industry. Noise control at test facilities has shown some excellent results, but noise control on an installation appears to be impractical. Since absolute measurements are always subject to question because of variation in methods of measurement and interpretation as well as variations between individuals concerning discomfort encountered, it is well to compare a known familiar noise with the new unknown noise.

The public is generally familiar with the noise level associated with conventional aircraft as the aircraft passes overhead. Therefore noise measurements on the ground were made as a piston engine aircraft passed overhead and also as a turbojet airplane passed overhead. Identical methods and measuring equipment were used for both tests, and both types of aircraft were operated at normal cruise power settings.

The results . . . indicate that noise levels for the turbojet were actually much lower than the noise levels of the piston aircraft. In addition the ground observer is subjected to the turbojet noise for only 20 seconds, while the piston aircraft noise persisted above background level for 70 seconds. In both cases the aircraft were flown directly overhead at an altitude of 1000 feet. The same pattern existed for the test made at 5000 feet.

Institute of Aeronautical Sciences
New York, New York
January 29, 1951

★

T. W. DRIESCH

Apparatus Department

MOTOR BRAKE: After man had invented the wheel, he was immediately confronted with the problem of bringing to a stop whatever the wheel moved. . . . With the advent of the machine age, it became more important to develop brakes to retard and stop revolving machinery, and the first hand brake resulted. . . . The later use of electric power, in the form of motor drives with ever-increasing speeds and horsepower, demanded brakes of greater capacity and reliability. Electricity then took the place of muscular effort.

During the past 50 years, designs have been developed with a multitude of variations in shoe or band arrangements, with one or more springs, and with numerous links, levers, and pins. The majority of those brakes had only one magnet and used a system of mechanical linkages to multiply the force of the magnet to release the shoe pressure.

The major objectives in the development of the new brake described in this article were: (1) to reduce the number of wearing parts, (2) to obtain faster operation, (3) to simplify the means of making adjustments, and (4) to have fewer parts. . . . These objectives aim at **decreased maintenance. Other advantages** include improved performance and appearance.

General Electric Review
February, 1951

★

A. H. HEMKER

Apparatus Department

FARM POWER: The fact that farmers are dependent on electricity more and more has brought to focus the last year or two a question: What do you do when the power goes off? . . .

Take a dairyman who is milking, say 50 cows. How does he milk them if his milking machine won't run? In some cases this may even be a physical impossibility. Think of the inconvenience on any farm if the water pump doesn't work. If the power interruption is of long duration, what about the farm freezer? Many farm homes are considerably electrified, and probably the most important electric item in the farm home is the electric motor that runs the oil burner or stoker that keeps the home comfortable.

Take the poultryman who may have chicks under the brooder or who heats the brooder house with an oil or stoker heating plant. Take the poultryman with a thousand layers or more who lengthens the working day of his layers by having lights in his poultry house. A few interruptions in this light cycle would throw his complete flock off production and might even put them into a molt.

Another example of the importance of electricity is the truck garden or greenhouse operator who has electric heat in his benches or who depends on automatic heat with his stoker to heat his greenhouse. Loss of power in these cases might mean a loss of considerable money.

A standby electric power generator is the answer to the above questions, but I believe it is necessary that we take a sensible view of the farmer's requirements, even though a farm may have 20 or 30 kilowatts of connected load. It isn't necessary that he protect himself for his possible maximum use. . . . I believe a three-kva generator will take care of most farmers' emergency needs. . . . I believe in most cases it would be silly to saddle the farm with a complete engine-generator set when the use of it may average only once a year. . . . All farmers have a prime mover which is used nearly every day. . . I am speaking, of course, of the farm tractor.

American Society of Agricultural Engineers
Chicago, Illinois
December 18, 1950

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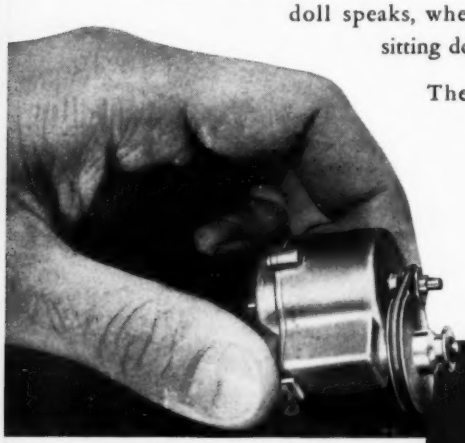

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